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ENVIRONMENTAL ASSESSMENT RECORD

FOR PROPOSED

OIL AND GAS LEASING

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

JAN 1978

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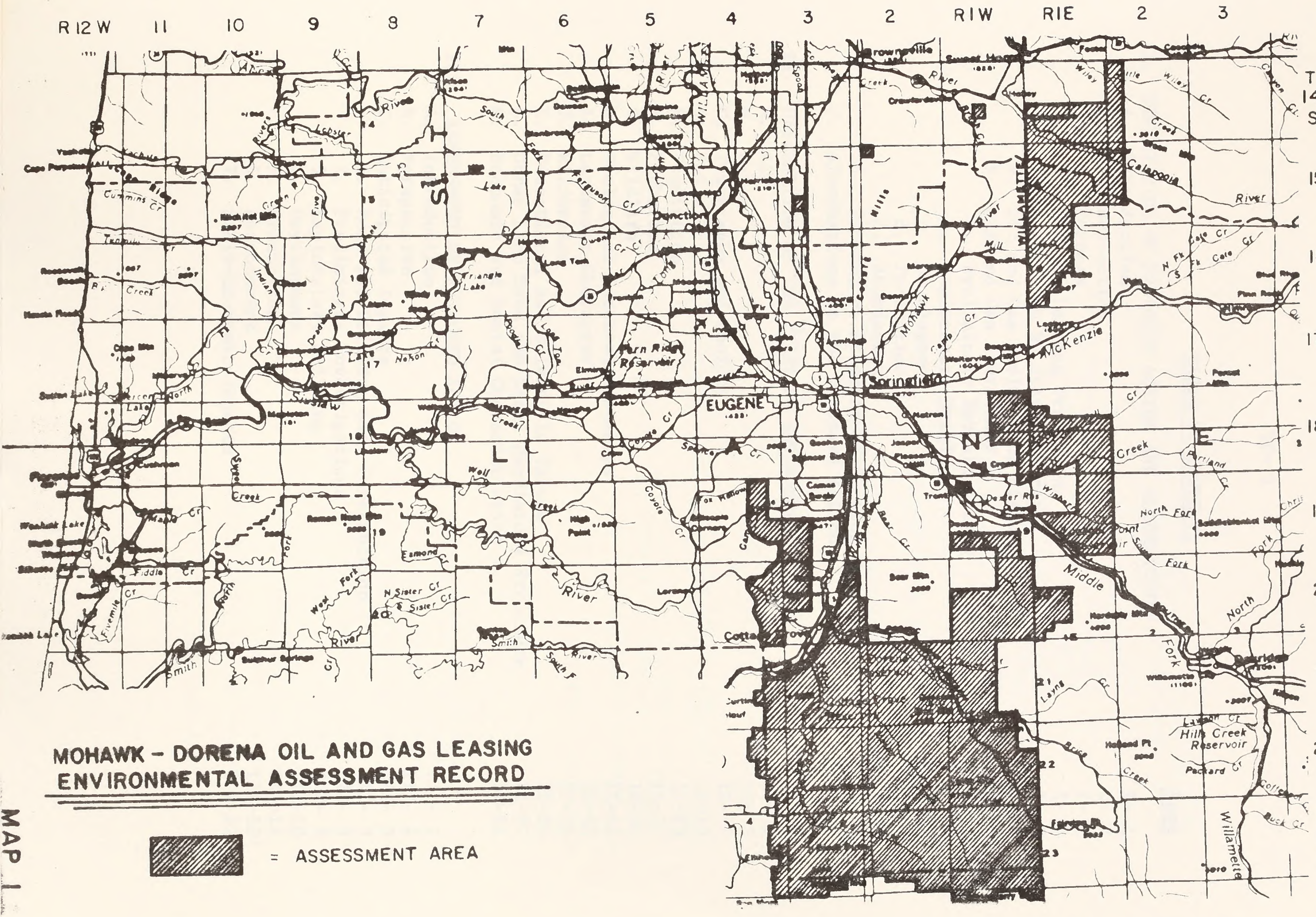
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Springfield
EUGENE
Fern Ridge Reservoir
Triangle Lake
Siuslaw
Coyote Cr
Middle Fork
North Fork
Hills Creek Reservoir
Willamette
Smith River
Cummins Cr
= ASSESSMENT AREA

MOHAWK - DORENA OIL AND GAS LEASING
ENVIRONMENTAL ASSESSMENT RECORD

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I. DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

A. Introduction

The potential impact of proposed oil and gas leasing on public lands in a portion of the Eugene and Roseburg BLM Districts is analyzed in this Environmental Assessment Record (EAR). The area under consideration is located in central Lane County with small portions extending into southwest Linn County and northcentral Douglas County (see Map 1). The areas include approximately 346,000 acres, of which 84,690.68 acres are public lands (primarily revested Oregon and California Railroad grant lands) administered by the Bureau of Land Management. An additional 1,174.46 acres is patented surface where the United States has reserved all mineral rights. The balance of approximately 260,000 acres consists of private and State lands and a small area of Federal land administered by the U.S. Forest Service.

As of the date of this record, 17,605.25 acres of public lands and reserved Federal mineral lands within the assessment area are under oil and gas lease application. Legal descriptions for the application areas are included in Appendix A.

The proposed action is the leasing of BLM-administered lands and reserved Federal mineral lands, so the major emphasis of this assessment is concentrated upon these lands within the EAR boundaries. However, impacts could be felt on intermingled private and State lands and on bordering land areas, so descriptions, impact analyses and possible mitigating measures are presented after considering the entire area.

This environmental assessment was prepared by an interdisciplinary team of BLM resource specialists. Information on the land and other resources was obtained from inventories and data furnished by Federal, State and local agencies and individuals having direct knowledge of the area.

A statewide overview of the cumulative effects of oil and gas leasing and development on Federal lands in Oregon is included in Appendix M.

B. Proposed Action

The proposed action involves the leasing of Federally-owned oil and gas resources, with special stipulations, pursuant to the Act of February 25, 1920 (41 Stat. 437), as amended (30 U.S.C. 181-263).

1. Purpose of Action

The purpose of issuing Federal oil and gas leases in Western Oregon is to permit exploration for and, if commercial reserves are discovered, development of oil and gas resources.

2. Federal Oil and Gas Leasing Procedures

a. Roles of Bureau of Land Management and U.S. Geological Survey

BLM administers Federal laws and regulations relating to mineral resources on land under its primary jurisdiction (public lands), Federal lands withdrawn for other agencies, acquired Federal lands, and Federal mineral reserves in private lands. BLM, in consultation with the U.S. Geological Survey (USGS) determines whether, and the conditions under which, Federal oil and gas leases will be issued. If the lands being considered for leasing are withdrawn for another Federal agency, that agency is involved in the process of determining whether the land will be leased.

After leases are issued on lands administered by BLM, the Geological Survey, in consultation with BLM, administers oil and gas operations on the leases. The Geological Survey is responsible for maintaining engineering, geologic, geophysical, economic and other technical expertise needed to assure compliance with applicable laws, regulations and Department objectives. BLM and Geological Survey responsibility for administration of oil and gas operations on Federal leases are described in Secretarial Order 2948 and the implementing working agreement. (Copies of the order and working agreement are included in Appendix B.)

b. Administration of Geophysical Explorations

Geophysical explorations are often conducted before an oil and gas lease is obtained. However, the procedures are described here to provide an overview of the full range of administrative activities relating to oil and gas operations on Federal lands.

If a person wants to conduct geophysical explorations on BLM-administered lands which he has not leased for oil and gas, he must file a notice of intent with the appropriate BLM district manager before he enters the land (43 CFR 3045). This regulation does not pertain to lands where the Federal Government owns the mineral rights but not the surface rights. When he signs the notice of intent form, the geophysical operator agrees to conduct the exploration activities according to terms and conditions designed to minimize adverse impacts. See Appendix C for a copy of the form and the terms and conditions. The applicant must also file a bond before entering the land.

When a notice of intent is received, a BLM district staff specialist reviews the proposed operation and may meet with the operator in an effort to minimize the environmental effects of the surveys.

Upon completion of operations, the exploration company must restore the area as nearly as practicable to its original condition.

Geophysical explorations conducted after an oil and gas lease has been issued are governed by post-lease procedures as described in Section I.B.2.e.

c. Pre-Lease Procedures

1) Land Use Planning

Land use capabilities and potential resource conflicts are considered in a document called a Management Framework Plan (MFP). The MFP indicates how land uses in a planning area will be coordinated and identifies constraints for future actions taken in the area. Basic resource data are recorded in inventory documents called Unit Resource Analyses (URAs). The Siuslaw and Upper Willamette URAs and MFPs contain information pertinent to this EAR.

2) Environmental Assessment

Before a decision is made on whether oil and gas leases will be issued in a specific area, BLM prepares an Environmental Assessment Record (EAR). The EAR describes the setting in which the action is to occur, possible environmental impacts of the proposed action and measures to reduce adverse impacts of the proposed action.

3) Lease Stipulations

Information gathered in the land use planning and environmental assessment processes and other data are used by BLM to determine whether oil and gas leases will be issued for specific lands and, if so, the conditions or stipulations to which the prospective lessees will have to agree prior to the issuance of the leases. Most of the stipulations in oil and gas leases issued in recent years relate to the prevention or mitigation of unfavorable environmental impacts.

All oil and gas leases issued by BLM at the present time contain an open-ended set of stipulations. The stipulations are included on BLM Form 3109-5; a copy is included in Appendix D. These stipulations insure that after the lease is issued, USGS and BLM have additional opportunities to specify measures the lessee must take to protect environmental values.

Oil and gas leases also contain site-specific stipulations. These stipulations are developed individually for each lease area.

4) Classification Report

Before a lease is issued, a classification report is prepared by the Geological Survey to determine whether the lease will be issued on a competitive or noncompetitive basis. The Geological Survey determines whether all or any parts of the area applied for are within a Known Geologic Structure (KGS). An area is classified as being within a KGS if it is within the trap, either stratigraphic or structural, of a producing oil and gas field as best as can be determined from the geologic data available at the time. If the area is in a KGS, it is not available for leasing until it is offered at a competitive lease sale. If the area is not within a KGS, it may be leased on a noncompetitive basis.

No Known Geologic Structures have been identified in Oregon.

d. Lease Issuance

If a tract has not been previously leased, a lease is issued on a noncompetitive basis to the first applicant (1) if the land is legally available, (2) if USGS determines that it is not a KGS, and (3) if BLM determines through the land use planning and environmental assessment processes that oil and gas development is acceptable and appropriate.

When leases outside KGSs expire, terminate, are relinquished or canceled, land use plans and environmental assessments are reviewed to determine whether the tracts should be reoffered for leasing and, if so, the kind of stipulations to be added to the new leases. The tracts are reoffered by being posted on a monthly list. All applications for the posted tracts received during the filing period are considered to have been filed simultaneously. A public drawing is held and one application is drawn for each tract.

If there are no simultaneous applications for a tract, it becomes available to the first application submitted subsequent to the drawing. Noncompetitive leases are currently issued for a primary term of ten years.

Since Oregon has no KGS areas at this time, no competitive leasing is scheduled in the State.

Lessees must furnish bonds conditioned upon compliance with the lease stipulations. Bonds must be furnished before a competitive lease is issued and before a drilling permit is issued on a noncompetitive lease.

e. Post-Lease Procedures

During the term of the lease, the Geological Survey supervises operations of the lessee in that portion of the lease tract within the "area of operations," (see the implementing working agreement for Secretarial Order 2948 in Appendix B for a definition of the area of operations). The Geological Survey asks BLM for recommendations on surface protection measures before the Survey acts on requests from lessees for approval of plans for drilling or other surface-disturbing operations. BLM administers the oil and gas leasing regulations, the terms of the lease and geophysical exploration activities in that portion of the lease tract outside an area of operations.

The "open-ended" lease stipulation (Form 3109-5) requires the lessee, prior to entry upon the land, to submit for approval to the Geological Survey a map and surface-use plan explaining the nature of the anticipated activity and surface disturbance. The lessee also submits this information to BLM. If the lessee proposes to conduct any activities which would disturb the environment, he will be required to obtain approval from the Survey at least once during the life of the lease. If he finds oil or gas and wishes to drill additional wells to develop the field or construct facilities needed to reach full production, he will be required to return to the Survey for approval of plans for each new stage of development. The information the lessee must furnish in the surface-use plan is listed in the Geological Survey's Notice to Lessees #6 (NTL-6). A copy is included in Appendix E.

For all exploratory well proposals, the USGS prepares an Environmental Assessment with input from BLM. If BLM so requests, the Geological Survey will also hold a joint field inspection with the operator, BLM and any other interested parties to analyze the environmental impacts of the proposed action. Stipulations are attached to the drilling permit to minimize adverse environmental impacts. The lessee may be asked to change the proposed well site if drilling in the original location would have severe adverse environmental impacts.

If oil and gas is discovered, lessees are required to submit additional lease development plans and permit requests to the

Geological Survey for approval. After USGS has reviewed the proposed plans and permit applications and consulted with and received input from BLM, the proposed plans are modified, if necessary, to insure that proper construction practices are followed. The lessee is required to prepare for contingencies such as fires, accidents, blowouts, spills and leaks and to notify various State and Federal agencies, such as the Environmental Protection Agency, in the event of an oil leak or spill.

If the BLM notifies the USGS prior to the commencement of a well-drilling operation that it desires a water well in case the exploratory well encounters a usable fresh-water zone and is later abandoned, the Geological Survey will contact the BLM prior to approving an abandonment plan. If the BLM elects to assume further responsibility for the well and to reimburse the operator for any recoverable casing left in the hole solely because it is to be completed as a water well, the Geological Survey will require the operator to abandon the well to the base of the deepest fresh-water zone of interest and complete it as a water well.

The Geological Survey is responsible for the final approval of abandonment operations when oil and gas operations are terminated. The Survey will not approve the abandonment unless reclamation is carried out to the satisfaction of BLM. When abandonment or cessation of operations results in expiration, cancellation or relinquishment of the lease, the Geological Survey and BLM inspect the leasehold area for compliance with the surface protection and reclamation stipulations in the lease and drilling permit. The lessee is required to reclaim the area insofar as practicable to its conditions prior to the oil and gas operations.

f. U.S. Reserved Mineral Lands

The BLM is responsible for the issuance of mineral leases on those lands where the surface was patented under a number of land laws which required the reservation of mineral rights by the United States. Geophysical exploration operations on such lands conducted prior to the issuance of an oil and gas lease are privately arranged between the geophysical operator and the surface owner. In issuing leases, the BLM may add special stipulations to protect environmental values just as is done on lands where both the surface and the mineral estate are Federally owned.

Post-lease operations are governed in the same manner as described above with certain additional requirements. As stated in USGS Notice to Lessees #6 (Appendix E), each application for a permit to drill or to conduct other surface-disturbing activities submitted by the lessee must contain information concerning the private surface owner's rehabilitation requirements. When satisfactory arrangements cannot be made between the surface owner and the lessee, the BLM is asked to recommend the necessary surface restoration requirements. When they are available, full consideration is given to the preferences of the surface owner. All operations on the lease are bonded and the lessee is responsible for any damage to surface resources or improvements.

g. Leasing Revenues

As of February 1, 1977, all noncompetitive onshore oil and gas leases require the following fees, rentals and royalties:

1) Application Fees

All lease applications require a filing fee of $10. All such fees go to the Federal Treasury.

2) Rentals and Royalties

Until production is achieved, an annual rental is charged at the rate of $1.00 per acre or fraction thereof. Upon gaining producing status, the rental is replaced by a royalty assessed at the rate of 12½% of the wellhead value of any oil or gas produced. The rentals and royalties are distributed as follows:

Public Domain Land
50% would go to the State of Oregon
40% would go to the Reclamation Fund to be administered by the Bureau of Reclamation for use in projects in the western states
10% would go the the Federal Treasury

Oregon & California Railroad Grant Lands (O&C)
25% would go to the Federal Treasury
75% would go to the 18 Oregon O&C counties of which 1/3 is refunded to the Federal Government for use by the BLM in managing the O&C lands

Within the assessment area, approximately 98 percent of the BLM-administered lands are O&C lands.

3. Regulation of Oil and Gas Operations by the State of Oregon

Oregon is an associate member of the Interstate Oil Compact Commission and has adopted many of the policies and model rules suggested by this group of State regulatory agencies. State rules require bonding, blowout prevention equipment, controlled disposal of brines and the cementing and casing of wells. State law also sets well spacing limits and provides for the protection of correlative rights of landowners. In

Use of both surface and ground water may be monitored by both the Oregon Department of Fish and Wildlife and the Water Resources Department. The latter department has the authority to stop water appropriation when stream flows fall below minimum requirements.

4. Summary of Oil and Gas Leasing and Exploration in Western Oregon

Oil and gas leasing and drilling activity in Western Oregon has fluctuated widely over the years since the first wildcat well was drilled near Newberg in 1902. The drilling has produced numerous shows of oil and gas but no commercial discoveries. Most of the more than 100 wells drilled up to 1975 in Western Oregon were less than 2,000 feet deep. More than 20 wells drilled since 1940 were over 4,000 feet deep. The deepest was drilled in 1955 in the Siuslaw National Forest in Lane County; it was drilled to a depth of 12,880 feet.

Almost all oil and gas drilling in Western Oregon has taken place on private land.

Ten exploratory wells have been drilled on Federal lands in Oregon. The only well drilled on Federal land in Western Oregon was the deep hole in the Siuslaw National Forest.

Drilling activities accelerated on private land, but not on Federal land, in Western Oregon in 1975.

5. Oil and Gas Operations

Petroleum operations progress through five phases: (1) peliminary investigations; (2) exploratory dirlling; (3) development; (4) production; and (5) abandonment.

Several phases may occur simultaneously in an area. One company may drill an exploratory well on a lease while another company conducts preliminary investigations on adjacent areas. However, if only one company is interested in the area, normally only one phase of the operation will take place at a time.

Exploratory wells are normally drilled on only a small percentage of the area covered by preliminary investigations.

a. Preliminary Investigations

Preliminary investigations often precede the issuance of a lease. They are described in this section to provide an overview of the entire range of oil and gas operations.

Preliminary investigations begin with an office review of geological and technical data available for the region. In many oil- and gas-producing regions, an office analysis may develop enough information to proceed with drilling without conducting additional preliminary investigations. However, the office analysis may indicate only a broad prospective area and further preliminary investigations may be required.

Preliminary investigations are made from the air and on the ground.

1) Airborne Investigations

Small aircraft and helicopters are used to conduct visual reconnaissance, photographic and geophysical surveys.

2) Surface Investigations

On-the-ground geological and geophysical surveys may involve either casual or intensive use of the land. Casual uses generally do not disturb the surface. Intensive uses include operations which require clearing of new access trails, movement of heavy equipment or other actions which can result in substantial surface disturbance.

Geological surveys normally are a casual use. Rock outcrops and topography are examined to determine the structural attitude and age of surface formations and geologic maps are prepared. In many areas, rock outcrops have been mapped and sufficient information obtained to enable the geologist to recommend a drilling location without conducting additional surface exploration work. However, when surface structures are not present or do not provide conclusive indications of subsurface structures, geophysical investigations may be needed to outline structures where oil or gas may be trapped.

Geochemical and soil-gas surveys involve casual use of the land. In geochemical surveys, the chemical contents of water, soil or vegetative samples are analyzed for the presence of oil or gas. In soil-gas surveys, soil samples are analyzed to determine whether minute traces of gas have escaped to the surface from petroleum reservoirs.

In geophysical surveys, subsurface formations are evaluated by analyzing properties such as gravity, electrical conductivity, magnetic susceptibility and structural attitude. The seismic survey is one of the most commonly-used geophysical methods. It is an intensive-use method and involves the use of heavy, truck-mounted equipment. Other geophysical methods, such as temperature, gravity, magnetic and radiation surveys, usually are confined to existing roads and trails.

In seismic surveys, a shock wave is sent into the subsurface and the time required for the wave to travel to and return from a subsurface horizon is recorded. A map of the subsurface can be drawn from an analysis of the differences in the time it takes the wave to be reflected back to the surface from the various rock formations. Explosive, thumper or vibrator methods are used to produce the shock wave.

In the explosive method, shot holes are drilled to a depth of 50-200 feet. 4-12 holes are drilled per mile of line. The holes are loaded with 5-50 pounds of explosives and detonated. The same hole may be reloaded and shot several times to find the depth and explosive charge returning the best reflection or refraction signal.

The thumper and vibrator methods pound or vibrate the earth to create a shock wave. Less than 50 square feet of surface area is required to operate the equipment at each test site. If there is brush or loose rock in the area, it may be removed to provide a more solid base for the test.

The sensors and energy source are typically located along straight seismic lines laid out on a one- to two-mile grid. Existing road systems are used where available. Lines may be cleared of vegetation and loose rocks to improve access for the trucks. Each mile of line cleared to a width of 8¼ feet utilizes one acre of land.

In rugged terrain that is relatively well roaded, such as the assessment area, the vibrator (or vibroseis) method is generally preferred due to lower operating costs and environmental considerations. The truck-mounted vibroseis units operate on roadbeds and involve no surface disturbance. A vibroseis crew consists of approximately 20 persons and can cover about two miles of road per day. On narrow roads, temporary blockages may occur.

b. Exploratory Drilling

This phase does not begin until a lease has been acquired by the operator. In areas where preliminary investigations are favorable and information warrants further exploration, exploratory drilling may be conducted. More precise data on the geological structure are obtained by stratigraphic tests utilizing shallow holes. The presence of suspected oil and gas deposits may be confirmed by wildcat drilling of deep holes.

1) Stratigraphic Tests

Stratigraphic test holes may be drilled 100-500 feet deep to locate geologic indicators. The holes can be drilled with truck-mounted equipment and disturb a relatively small area. Occasionally, stratigraphic tests may be drilled thousands of feet deep using large rigs. Stratigraphic holes in areas of shallow, high-pressure gas zones are cased. The roads and trails constructed for access to such test sites are temporary and involve minimal construction. The drill site may occupy approximately 900 square feet and is sometimes placed in the center of a new or existing trail.

2) Exploratory Wells

Exploratory wells require large drilling rigs with support facilities and may disturb a larger surface area than stratigraphic tests. Required facilities include roads, drill pads, mud pits and, in some rare cases, camps and airports.

Nationwide, one out of every seven exploration wells drilled in 1974 was finished as a producer. However, only one in 59 resulted in the discovery of significant recoverable reserves (more than one million barrels of oil or six million cubic feet of gas). Of the 200 or so wells drilled in Oregon, none has been financially successful.

After a drilling site has been selected, a heavy-duty road for moving the drilling rig and other equipment to the location is built if one does not already exist. New roads are usually designed for permanent access.

The well site occupies about an acre and is cleared of all vegetation and graded nearly flat. Depending on terrain conditions in the area, the well site or drill pad and roads may or may not be graveled. The drilling rig, mud pumps, mud pit, generators, pipe rack and tool house are located on the drill pad. Other facilities, such as storage tanks for water and fuel, may be located on or near the drill pad.

A water supply is required for mixing drilling mud, cleaning equipment, cooling engines and other uses. Water needs generally range between 1,000-2,000 gallons a day per well during drilling. Most of this water is used in preparing drilling mud. The average drilling time per well is about three or four weeks. In appropriate terrain, a pipeline may be laid to a nearby stream where adequate water is available or to a water well. In rugged terrain, water can be trucked to the drilling site.

The drilling mud is maintained at a specific weight and viscocity to cool the bit, reduce the drag of the drill pipe on the sides of the well bore, seal off any porous formation, contain formation fluids to prevent a blowout or loss of drilling fluid and bring the drill cuttings to the surface for disposal. Various additives are caustic, toxic or acidic in nature. Others are simply weight additives and fluid loss additives. (Drilling mud materials are listed in Appendix F.)

A well completion requires installation of steel casing between the surface casing and the pay zone. The casing is selectively cemented to provide stabilitiy and to protect specific zones, such as fresh-water aquifers. The drilling rig and most of the support equipment are usually moved from the well site after the casing is cemented.

Storage tanks are required to hold oil produced from an exploratory well. A separator may be required to separate the oil and gas. If water is produced with the oil, a treater may be needed.

If gas is discovered, the operator is allowed to flare only enough gas for a short period of time to determine the well's capabilities. The well is then shut in until a gas line is constructed.

Exploratory drilling in frontier areas, such as Western Oregon, usually involves only one drilling crew which typically consists of about 20 persons.

The completion of an exploratory well as a commercial producer usually marks the beginning of the development phase.

c. Development

1) Well Spacing Pattern

A well spacing pattern may be established before development drilling begins to determine the spacing unit assigned to each well.

If a well spacing pattern has not been previously established for the area, the operator proposes a spacing pattern to the State regulatory agency and to USGS for approval pursuant to the Oil and Gas Operating Regulations, 30 CFR 221. Information considered by USGS in establishment of a well spacing pattern includes data obtained from the discovery well on the porosity, permeability, pressure, lithology and depth of formations in the reservoir, data on well producing rates and type of production (predominantly oil or predominantly gas) and the effects of the proposed well spacing pattern on the economics of recovery.

Most spacing patterns established at the present time for Federal leases set minimums of 40 acres per well for oil production and units of 160, 320 or 640 acres per well for gas production.

2) Drilling Procedures

Procedures used in drilling development wells are about the same as those used for an exploratory well except that there usually is less subsurface sampling, testing and evaluation. Development operations may involve an additional 1-3 drilling crews.

3) Surface Use

Facilities required for development drilling may include access roads; well sites; flowlines; storage tank batteries; facilities to separate oil, gas and water; and injection wells for salt water disposal. In remote locations, camps and air strips may be required.

Access roads usually are better planned, located and constructed than roads built during the drilling of exploratory wells.

When an oil field is developed on the current minimum spacing pattern of 40 acres per well, the wells are ¼ mile from each other. If a section (one square mile) is developed with 16 wells, at least four miles of access roads are likely to be built and 4-6 miles of flowlines installed between the wells and the tank batteries. Models of surface use requirements of oil production on 20-acre to 60-acre per well spacing patterns are illustrated in Appendix G.

Surface uses in a gas field will be significantly less than in an oil field because gas wells usually are drilled on 160-acre per well or large spacing units. A 160-acre per well spacing pattern requires four wells per section and two miles of access roads and pipelines. Separation and storage facilities are not required for gas production unless the production is rich in liquids or condensate. It may be sold without separation and the purchaser may separate the liquids at a central processing point far removed from the lease.

d. Production

Oil and gas field facilities are illustrated in the following diagram.

1) Well Facilities

a) Oil Fields

Pressures in some petroleum reservoirs are great enough to force oil to the surface. The result is a flowing well. However, most oil wells in the United States require the use of some means of artificial lift to bring the oil to the surface. Pumping and a technique known as "gas lift" are the two methods of artificial lift used at present. Flowing wells and wells with gas lift facilities require a minimum of equipment at the surface and produce little or no sound. All pump systems require more surface equipment and create more noise than flowing wells and gas lift facilities.

i) Flowing Wells

The surface equipment at the head of a flowing well may be limited to a series of valves, or "Christmas tree," and a fenced service area ranging from 15'x15' to 50'x50' around the wellhead and Christmas tree.

ii) Artificial Lifts

aa) Pumping

Over 90 percent of the oil wells in the United States in 1971 were on artificial lift and most of the artificial lift wells used sucker rod pumps. Other pumps commonly used on oil wells are hydraulic and centrifugal pumps.

All of the pump systems require some surface equipment and fuel or electric powerlines. All generate some noise ranging from almost none for electric motors to high noise levels for single-cylinder gas engines.

iii) Gas Lift

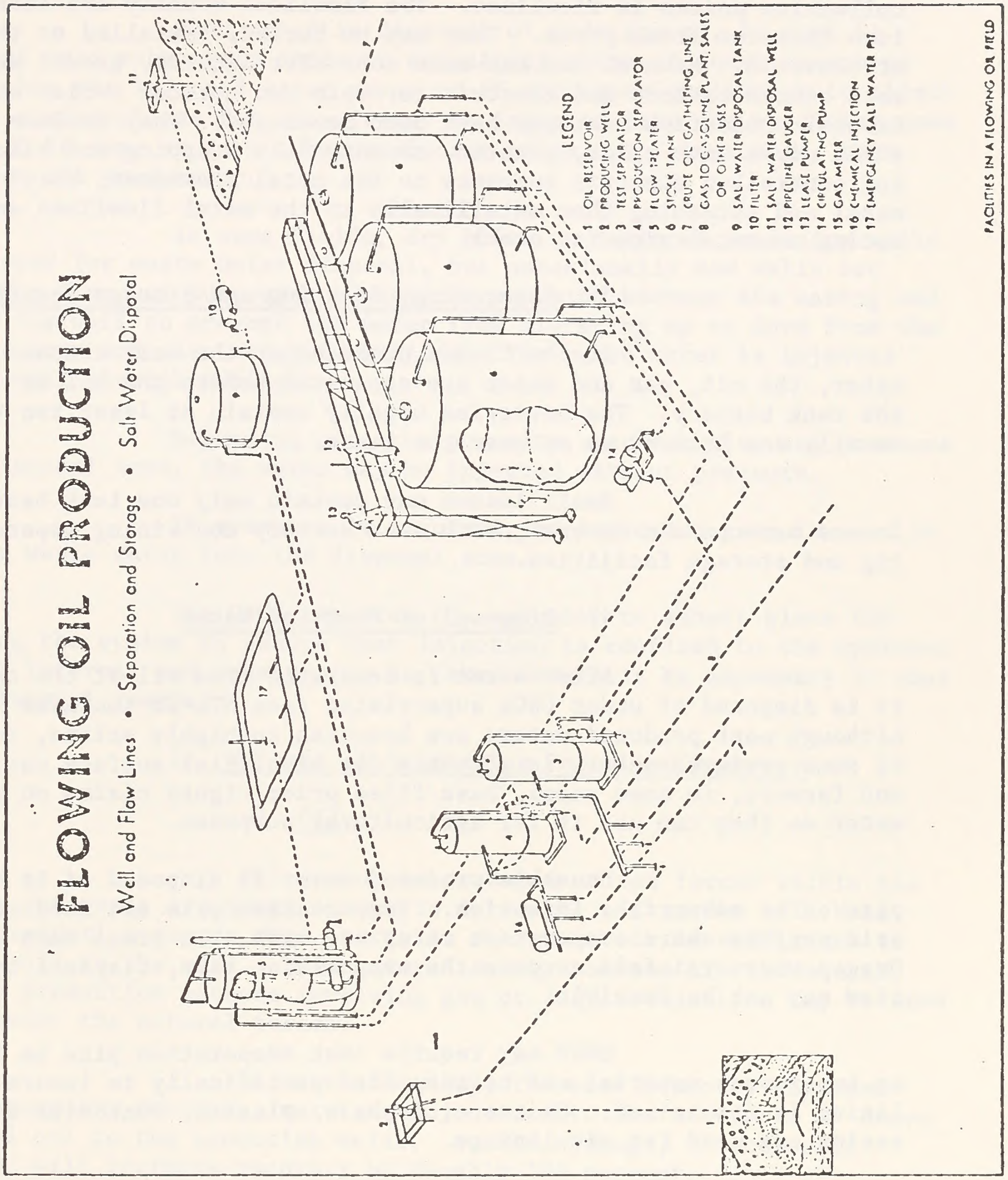
Gas lift is used in some oil fields where low-cost, high-pressure natural gas is available and where pressure in the petroleum reservoir is sufficient to force the petroleum part of the way up the well. The addition of gas lowers the specific gravity of the petroleum so that it flows to the surface. The system is quiet and uses little ground. However, it will be used less in the future as supplies of high-pressure natural gas decline.

b) Gas Fields

Most gas wells produce by normal flow and do not require pumping. Surface use at a flowing gas well usually is limited to a 20'x20' fenced area. If water enters a gas well and chokes off the gas flow, a pump may be installed to pump off the column of water.

2) Flowlines

Crude oil usually is transferred from the wells to a central collection point, or storage tank battery, before it is transported from the lease. Natural gas is often sold at the wellhead and transported directly off the lease. If processing is required to remove liquid hydrocarbons or water, however, the gas may be transferred to a central collection point prior to sale.


FLOWING OIL PRODUCTION
Well and Flow Lines • Separation and Storage • Salt Water Disposal
LEGEND
1 OIL RESERVOIR
2 PRODUCING WELL
3 TEST SEPARATOR
4 PRODUCTION SEPARATOR
5 FLOW TREATER
6 STOCK TANK
7 CRUDE OIL GATHERING LINE
8 GAS TO GASOLINE PLANT, SALES OR OTHER USES
9 SALT WATER DISPOSAL TANK
10 FILTER
11 SALT WATER DISPOSAL WELL
12 PIPELINE GAUGER
13 LEASE PUMPER
14 CIRCULATING PUMP
15 GAS METER
16 CHEMICAL INJECTION
17 EMERGENCY SALT WATER PIT
FACILITIES IN A FLOWING OR FIELD
1
2
11
12
13
14
16
17

Oil and gas are transferred from the wells to central collection points in flowlines. The flowlines usually are three- or four-inch diameter steel pipes. They may be buried, installed on the surface or elevated. Natural and man-made corrosive liquids, ground water and salt concentrations and electric currents can corrode buried steel pipe. Several protective measures have been developed. They include coating the steel pipes with paint, plastic, cement, felt wrapping and bitumen; feeding controlled electric currents to the metal flowlines; burying masses of metal and attaching them metallically to the metal flowlines and substituting nonmetal pipe for steel.

3) Separating, Treating and Storage Facilities

If the fluids produced at the well contain gas and water, the oil, gas and water are separated before the oil is stored in the tank battery. The batteries usually contain at least two tanks and usually are located on or near the lease.

Small leases may contain only one tank battery. Large leases may contain several, with each battery containing separating, treating and storage facilities.

4) Disposal of Produced Water

After water is separated from oil at the tank battery, it is disposed of under USGS supervision (see NTL-2B included in Appendix E). Although most produced waters are brackish to highly saline, the quality of some produced waters is adequate for beneficial surface use. Ranchers and farmers, in some cases, have filed prior rights claims on produced water so they can use it for agricultural purposes.

Unusable produced water is disposed of in evaporation pits or by subsurface injection. Evaportation pits are used mainly in arid regions where evaporation rates are high. In areas such as Western Oregon where rainfall exceeds the evaporation rate, disposal by evaporation may not be feasible.

USGS may require that evaporation pits be lined with an impervious material and be inspected periodically to insure that the lining is maintained. Concrete, asphalt, plastic, bentonite and epoxy resins are used for pit linings.

Because waste water seldom issues from heater-treaters or gun barrels completely free from oil, oil skimmer pits are installed between the separating facilities and the evaporation pits when surface disposal is used.

When water is disposed of underground, it must be introduced into subsurface horizons containing water of equal or poorer quality than the injected water or water of such poor quality as to eliminate any practical use for it. It may be injected into the producing zone from which it came or into other producing zones. In some cases, this stimulates oil production.

In some fields, dry holes or depleted producing wells are equipped for waste water disposal, but occasionally new wells are drilled for disposal purposes. Cement is squeezed between the casing and sides of the well to prevent the water from migrating up or down from the injection zone and into other formations. The waste water is injected down the well through tubing.

Depending upon the porosity, permeability and pressure of the disposal zone, the water may be injected without pressure.

If pressure is required, an injection pump is used to force the waste water into the disposal zone.

The USGS requires the operator to submit plans for monitoring the system to assure that injection is confined to the approved injection interval and measures to be taken should it be necessary to shut in the disposal system.

5) Methods of Increasing Petroleum Recovery

a) Oil

Oil cannot be produced unless forces within the petroleum reservoir are great enough to drive the oil to the well bore. Primary production occurs when energy in the reservoir is sufficient to drive the oil to the well. When natural energy sources are inadequate, secondary production methods involving gas or liquid injection may be used to supplement the natural forces.

In water flooding, the most commonly employed form of secondary recovery, water is injected into the reservoir to drive additional oil to the producing wells. On the average, a successful waterflood will increase recovery by roughly 100 percent.

Other secondary techniques for improving oil recovery have been tested, including miscible flooding (injecting chemical compounds with water), fire flooding (starting a controlled fire in the reservoir) and steam flooding (injecting steam into the reservoir). Some of the techniques have been used for tertiary recovery after a water flood.

Natural gas also is injected into some oil reservoirs during primary recovery as a pressure maintenance program.

b) Gas

In some gas condensate reservoirs, some of the components of the gas condense into liquid form near the well bores when production reduces pressures in the reservoir. The resulting reduction in permeability may cause a significant loss in recovery. To prevent this, gas is injected to maintain pressure above the lower condensation pressure.

6) Land Required for Oil- and Gas-Producing Facilities

Possible land requirements for oil field facilities on leases with well spacing patterns ranging from 20-640 acres per well are delineated in Appendix G. The land uses for all facilities in a developed field may range from 22.4 acres per square mile with a 20-acre per well spacing pattern to 2.4 acres per square mile with a 640-acre well spacing pattern.

Less land is usually used in gas fields than in oil fields because gas production does not require storage on the lease.

7) Employment

The number of people required to operate an oil and gas field varies with the characteristics of the production and the number of leaseholds in the field. If the wells flow without pumping, one employee in a large, modern field can control production on 10-20 wells. If oil storage tanks are manually gauged and sampled, one employee can service approximately 25 tanks. If automatic gauging and sampling devices have been installed, one person can service the equivalent to 100-150 tanks. In a large, modern field, one five-man maintenance crew can service up to 50 wells.

e. Abandonment

1) Exploratory and Development Wells

Dry exploratory and development wells normally are plugged before the drilling rig is removed. This allows the operator to use the drilling rig to plug the hole and avoid bringing in other plugging equipment. The operator must obtain permission from the USGS district engineer to plug the well.

Well plugging requirements vary with the characteristics of the rock formations, subsurface water and the well. Generally, however, the hole is filled with heavy drilling mud to the bottom of the cemented casing. A cement plug is installed in the bottom of the casing, the casing is filled with heavy mud and a cement cap is installed on top of the well. In uncultivated areas, a pipe may be installed as a monument giving location and name of the well. In croplands, the casing is cut off and capped below plow depth and no monument is installed. Plugging requirements provide for protection of aquifers, known oil- and gas-producing formations and zones of good porosity in deep wells by placement of additional cement plugs.

After plugging is finished, the drilling rig is removed and the surface, including the reserve mud pit, is restored to its original condition, insofar as possible and according to requirements of the surface management agency. The operator's report of abandonment is approved by USGS after the surface restoration has been approved by the surface management agency.

2) Production and Injection Wells and Related Facilities

Before a lessee abandons a former producing well, he must demonstrate its unsuitability for further profitable production to the USGS district engineer. A copy of the operator's notice of intention to plug and abandon is transmitted to the surface management agency to obtain the agency's recommendations on surface restoration.

In some cases, wells are plugged as soon as they are depleted. In other cases, depleted wells are not plugged immediately but are allowed to stand idle for possible later use in a secondary recovery program.

Truck-mounted equipment is used to plug former producing wells. In addition to the measures required for a dry hole, plugging of a depleted producing well includes the installation of a cement plug in the perforated section in the former producing zone and, if casing is salvaged, a cement plug is put across the casing stub. In cultivated areas, the cement pumpjack foundations are removed or buried below plow depth. In areas where removal or burial would cause more surface damage than the foundations, they are left at the site.

When an entire lease is abandoned, the separators, heater-treaters, tanks and other processing and handling equipment are removed and the surface restored. Flowlines and injection lines installed on the surface are removed, but buried lines usually are left in place. The operator's bond with the Federal Government is not terminated until the surface management agency has approved surface restorations, USGS has approved subsequent reports of abandonment and royalties due the Federal Government have been received.

6. Summary of Standard Mitigating Measures

The preceding sections on Federal leasing procedures and State regulation of oil and gas operations refer to regulations and standard notice forms and stipulations which would apply to all geophysical explorations for oil and gas and/or activities of oil and gas lessees on public lands in Oregon. The notice forms, stipulations and regulations are summarized below.

a. "Notice of Intent to Conduct Oil and Gas Exploration Operations" BLM Form 3040-1

Geophysical exploration companies are required to complete this form before conducting geophysical operations on public lands. The form contains terms and conditions under which the operations must be conducted. More detailed conditions may be established to meet the unique requirements of the area where operations will be conducted. (Appendix C)

b. Section 2, Paragraph (q) of the Federal Oil and Gas Lease Form BLM Form 3120-7

"Protection of the Surface, Natural Resources and Improvements." (Appendix H)

c. "Surface Disturbance Stipulations" BLM Form 3109-5

These are the "open-ended" stipulations. They are made a part of each oil and gas lease issued by BLM at the present time. These stipulations insure that, after the lease is issued but before drilling operations are started, USGS and BLM have additional opportunities to establish conditions which the lessee will have to meet. (Appendix D)

d. "Cultural Resource Stipulations to Oil and Gas Leases"

This is the cultural resource protection stipulation included in all oil and gas leases issued in Oregon at the present time. (Appendix I)

e. 30 CFR 221

These are the Geological Survey's Oil and Gas Operating Regulations. Among other things, they include requirements relating to well casing, well abandonment and other mitigative measures.

f. Geological Survey Notices to Lessees and Operators of Federal Oil and Gas Leases

Notices to lessees and operators (NTLs) transmit the Geological Survey's operating requirements to lessees.

1) NTL-2B prescribes requirements for handling, storing and disposal of water produced from oil and gas wells. (Appendix E)

2) NTL-3 requires lessees to report discharges of pollutants and prescribes the contents of the reports.

3) NTL-4 requires lessees to pay royalties on oil and gas lost because of blowouts, fires or other reasons.

4) NTL-6 formalizes the requirement by the Geological Survey that an oil and gas operator furnish a surface use and operating plan to the Survey and BLM and receive approval before entering the lease to conduct drilling operations. USGS and BLM use information in the surface use plan and other data collected by the agencies to develop environmental protection measures. The measures are included as conditions of the drilling permit issued by USGS. (Appendix E)

g. 40 CFR 112

These U.S. Environmental Protection Agency regulations identify procedures, methods and equipment to be used to prevent the discharge of oil from nontransportation-related onshore and offshore facilities into navigable waters. The regulations apply to owners and operators of facilities engaged in oil and gas drilling, producing, gathering, storing and other nontransportation-related activites. Oil and gas operators are required in the regulations to prepare Spill Prevention Control and Countermeasure Plans.

h. 40 CFR 1510

These Environmental Protection Agency regulations contain the National Oil and Hazardous Substances Pollution Contingency Plan. As stated in the regulations, the plan "provides for a pattern of coordinated and integrated response by departments and agencies of the Federal Government to protect the environment from the damaging effects of pollution discharges. It promotes the coordination and direction of Federal and State response systems and encourages the development of local government and private capabilities to handle such discharges."

In addition to these Federal regulations, stipulations and administrative procedures relating to Federal lands, an oil and gas operation in Oregon would be subject to State laws and regulations regarding pollution control. The following State regulations and stipulations are applicable:

i. Chapter 632 of the Oregon Administrative Rules

These are the Department of Geology and Mineral Industries' regulations on oil and gas operations.

j. "Special Conditions to Apply to All Deep Well Exploratory Drilling in Oregon"

The Department of Environmental Quality and the Department of Geology and Mineral Industries agreed in September 1975 that these stipulations would be part of the future drilling permits issued by the Department of Geology and Mineral Industries. (Appendix J)

C. Alternatives to the Proposed Action

Two alternatives will be considered and evaluated. They are:

1. No Leasing

This alternative involves declining to lease any public lands within the assessment area for oil and gas exploration. A decision not to lease an individual tract or parcel of land where the potential adverse environmental impacts are judged to outweigh the potential benefits of oil and gas exploration and development is a possible outcome of the proposed action as described above and is thus not a part of the general "no leasing" alternative.

2. Leasing Under No Controls Other Than Those Required by Law or Regulation

Under this alternative, public lands within the assessment area could be leased with no control except the obligation to comply with applicable laws and regulations.

II. DESCRIPTION OF THE EXISTING ENVIRONMENT

A. Air

Within the assessment area, air quality is considered relatively good on an annual basis. The few industries and a light to moderate population density have little negative impact on the air quality. During summer months, with the northerly shift of prevailing winds, air pollutants from the Eugene-Springfield metropolitan area and northern Willamette Valley drift into the assessment area and are trapped by the topography and frequent temperature inversions. This drift is evidenced by an increased visual haziness which, on occasion, is greatly compounded by agricultural burning to the north.

Conversely, the assessment area's potential influence upon the regional airshed must be recognized. Management activities can add to the deteriorating trend in air quality within the Eugene-Springfield area. This trend is a primary concern throughout the entire Willamette Valley and might best be expressed by the following excerpt from a Lane County technical report:

> "The Willamette Valley may generally be described as a bowl, bounded by mountain ranges on the west, east and south. Temperature inversions act as a lid over the bowl. The mountains keep the air from escaping the valley sides and the inversion stops the air from escaping vertically.
>
> "It is the topography of the valley, the severely restricted crosswinds and the frequency of temperature inversions that lead scientists to feel if projected growth and urbanization are reached, the valley airshed could potentially be the most polluted in the United States." 1/

Air quality is not monitored within the EAR area, although monitoring stations are maintained in Cottage Grove and the Eugene-Springfield area.

For Lane County as a whole, the sources of air pollutants are estimated as follows: 62.7 percent from transportation exhaust emissions, 15.3 percent from open burning, 19.6 percent from industrial sources and 2.4 percent miscellaneous emissions. 2/ The seasonal variation of air pollution potential for the area is given in Table 1.

1/ Preliminary Comprehensive Land Use Plan for the Willamette-Long Tom Subarea, Technical Report (Lane County, Oregon, March 1975), p. 46.

2/ Preliminary Comprehensive Land Use Plan for the Row River-London Subarea, Technical Report (Lane County, Oregon, 1975), p. 49.

TABLE 1
SEASONAL VARIATION OF AIR POLLUTION POTENTIAL IN THE UPPER WILLAMETTE VALLEY*

Season	Stagnation Upper Layer	Lower Layer	Mixing Between Upper & Lower Air Layers	Air Pollution Potential
Spring	Absent	Present briefly at night	Present	Low
Early Summer	Absent	Present briefly at night	Present	Low
Summer	Present	Present, except in the afternoon, persisting several weeks at a time	Absent	High
Fall	Present	Present, often persisting for a week or more	Absent	Very High
Winter	Absent	Present for a day or two at a time; frequent interruption	Generally Present	Moderate

*Source: Crises Air, Central Lane Planning Council (now L-COG), 1968.

B. Water

The assessment area is located in the southern end of the Willamette Basin and extends a short distance into the Umpqua Basin along the southwest EAR boundary. More specifically, major portions of four subbasins are involved. These include the Coast Fork Willamette subbasin in the south which constitutes the bulk of the assessment area, the westerly portions of both the Middle Fork Willamette and McKenzie subbasins and the southerly portion of the Santiam subbasin on the north in Linn County.

The assessment area has a temperate marine climate characterized by wet winters and relatively dry summers. The weather is influenced predominantly by maritime winds. Precipitation averages about 50 inches per year with 70 percent falling during the winter months of November through March. Most precipitation falls as rain. Snow averages only about eight inches per year in one- or two-inch occurrences of very short duration over most of the assessment area, although a snowpack may accumulate at the highest elevations along the southern EAR boundary. A graph of the annual distribution at Eugene, Oregon, is shown by Figure 2. Though precipitation varies in relation to elevation, the annual distribution pattern for the assessment area remains similar to that of Eugene. Precipitation begins to rapidly taper off in April, reaching a "trace" level in the midsummer months. During this period, evaporation far exceeds rainfall, resulting in the usual summer drought.

1. Surface Water

There are a myriad of small rivers and streams throughout the assessment area. The majority of these smaller drainages are characterized as swift mountain streams, many with gradients exceeding 150-200 feet per mile. The primary water source, especially for the smallest streams, is runoff which averages about 30-40 inches per year, or two-thirds of the annual precipitation. The result is that the water flow in many of these small drainages is intermittent, drying up in the droughty summer months. Those that continue to flow during the drier seasons are fed by springs far too numerous to attempt location.

As the streams reach lower elevations, they form the major streams of the assessment area: Sharps Creek, Mosby Creek, Big River, Row River and the Coast Fork in the Coast Fork Willamette subbasin; Lost Creek, Fall Creek and Winberry Creek in the Middle Fork Willamette subbasin; the Mohawk River in the McKenzie subbasin; and the Calapooya River in the Santiam subbasin. The Coast Fork Willamette, Row River, Middle Fork Willamette, Fall Creek and Winberry Creek are all regulated by Corps of Engineers flood control reservoirs. Cottage Grove Reservoir and portions of Dorena, Lookout Point and Fall Creek Reservoirs lie within the boundaries of this assessment.

Hydrologic monitoring stations are maintained by the U.S. Geological Survey, Lane County and the Oregon Department of Environmental Quality on the Mohawk and McKenzie Rivers, Fall and Winberry Creeks, Middle Fork Willamette, Lost Creek, Coast Fork Willamette, Row River and Mosby Creek. Minimum flow requirements have been established for the Middle Fork Willamette, Fall Creek, Coast Fork Willamette, Row River, McKenzie River and the Mohawk River.

There are no known domestic water supply systems (exclusive of those serving single residences) utilizing surface sources within the assessment area or downstream from it. Approximately 80 percent of rural Lane County residents rely upon individual wells while 20 percent rely upon surface sources.

Because of regulation by reservoirs, summer flows of the major rivers below the dams are usually sufficient to meet present demand. Possible low-flow problems exist on Lost Creek, the Coast Fork Willamette above Cottage Grove Reservoir, Row River above Dorena Reservoir and the Mohawk River where water right allocations may exceed low summer flows, particularly during dry years.

2. Ground Water

Supplies, though usually of high quality, are generally small but adequate for domestic, stock or small commercial use. There is very little industrial use of ground water and total use can be classed as small.

The upland aquifers, comprising the vast majority of the assessment area, are primarily volcanic rocks of the Little Butte Series and Sardine Formation which typically yield 10-20 gallons per minute to wells. Older marine sedimentary rocks and interbedded volcanic strata in the valley of the Coast Fork and north and west of Cottage Grove generally yield less water to wells, in the 2-10 gallon per minute range. Much of the water from these upland aquifers is obtained from small saturated zones perched above the regional water table.

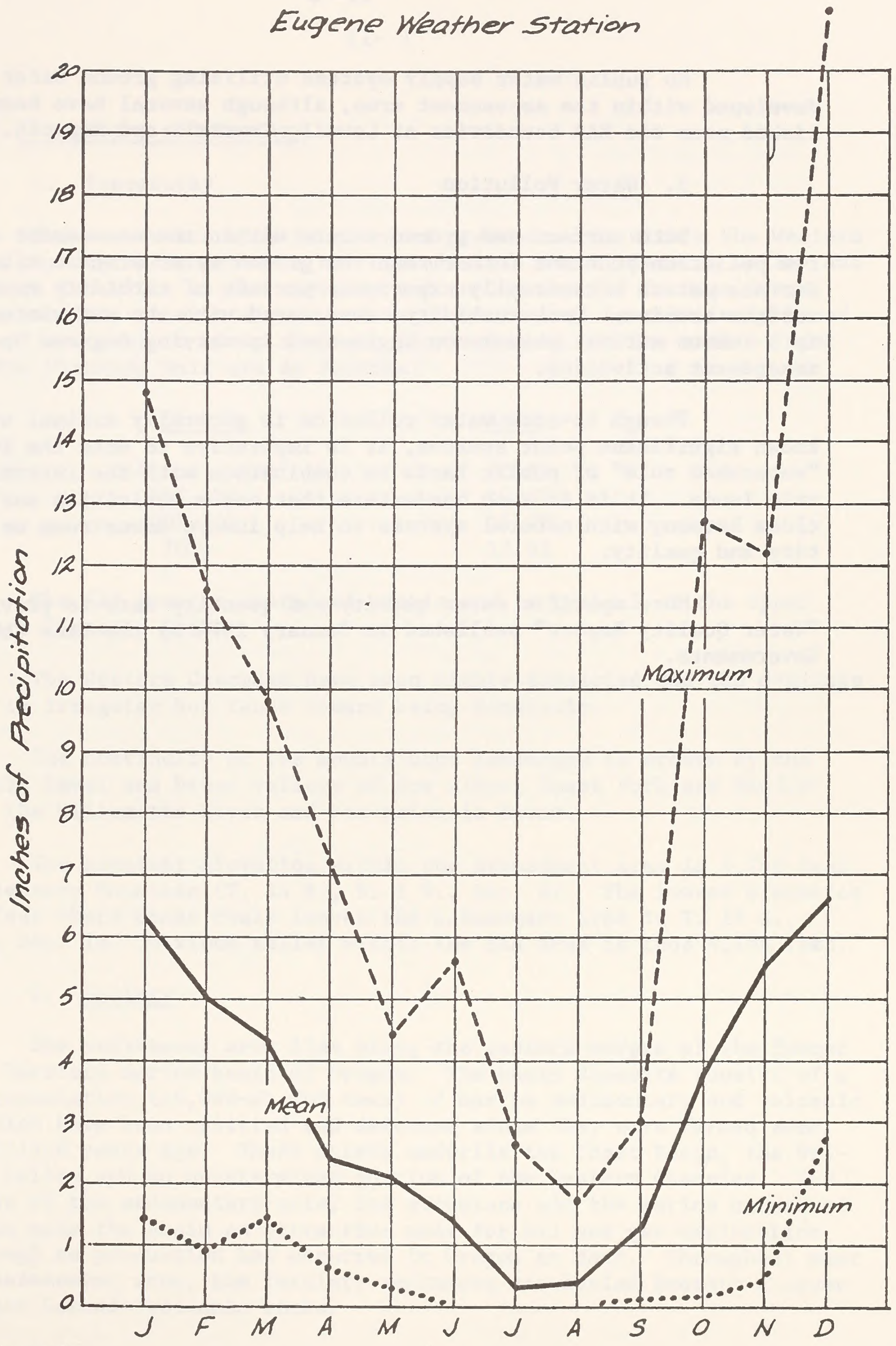
Alluvial deposits of sand, gravel and other unconsolidated sediment occur in rather narrow bands along the major drainages (see Map 2). Wells in these materials yield about 50 gallons per minute and locally up to 200 gallons per minute.

Ground water quality is generally within acceptable limits except for certain localized conditions. Unsafe arsenic concentrations occur in some wells in the southwest part of the assessment area, particularly north and west of Cottage Grove and in the Coast Fork valley. The arsenic-producing wells are found in general association with the Fisher Formation.

Figure 2

Monthly Precipitation

Eugene Weather Station



Source:

1969 Willamette Basin Comprehensive Study
Appendix B, Hydrology, Table II-8

No public water supply systems utilizing ground water have been developed within the assessment area, although several have been established near the EAR boundaries at Lowell, Creswell and Marcola.

3. Water Pollution

Both surface and ground waters within the assessment area have few pollution problems (other than the ground water arsenic cited above). Surface waters occasionally experience periods of turbidity resulting from surface erosion. Such turbidity, associated with the wet winter season, is a common natural phenomenon aggravated in varying degrees by resource management activities.

Though on-site water pollution is generally minimal with no known significant point sources, it is imperative to note the fundamental "watershed role" of public lands in combination with the intermingled private lands. It is in such headwaters that man's activities must be in close harmony with natural systems to help insure downstream water quantity and quality.

More specific water quality and quantity data is provided in the "Water Quality Report" published in January 1974 by the Lane Council of Governments.

C. Topography and Geology

1. Topography

The assessment area is situated predominantly within the Western Cascades physiographic province but extends into the Willamette Valley and Coast Range foothills in the vicinity and to the west of Cottage Grove. The area is hilly to mountainous and is characterized by relatively broad ridges and moderate to steep slopes. Slope classes for the entire Upper Willamette Planning Unit are as follows:

Slope	Area
25% and under	50.8%
25%-40%	19.3%
40%-70%	16.4%
70%+	13.6%

The EAR area is contained within and is typical of the Upper Willamette Planning Unit.

The Western Cascades have been highly dissected and the drainage pattern is irregular but tends toward being dendritic.

The continuity of the mountainous landscape is broken by the relatively level and broad valleys of Row River, Coast Fork and Middle Fork of the Willamette River and the McKenzie River.

The greatest elevation within the assessment area is 4,766 feet on Huckleberry Mountain (T. 24 S., R. 1 W., Sec. 6). The lowest elevation is 600 feet where Camas Swale leaves the assessment area in T. 19 S., R. 4 W., Sec. 14. Maximum relief within the EAR area is thus 4,166 feet.

2. Geology

The assessment area lies along the eastern margin of the former western Tertiary marine basin of Oregon. The basin deposits consist of a thick accumulation (10,000-25,000 feet) of marine sedimentary and volcanic rocks which have been uplifted and deformed since they were formed some 25-65 million years ago. These strata underlie the Coast Range, the Willamette Valley and an undetermined portion of the Western Cascades. The thickness of the sedimentary pile, its structure and the marine nature of the rocks make the basin an attractive area for oil and gas exploration even though no production has occurred in Oregon to date. Throughout most of the assessment area, the Tertiary sediments are buried beneath a cover of younger Cascade volcanic rocks.

a. Stratigraphy

The rocks exposed within the area range in age from late Eocene (approximately 40 million years old) to Recent (see Map 2).

1) Fisher Formation

The oldest formation outcropping within the assessment area is the Fisher Formation which occurs westward from the vicnity of Cottage Grove. The entire formation is nonmarine. The basal beds are coarse conglomerates which may be up to 50 feet thick and which, in turn, are overlain by coarse tuffs and agglomerates of predominantly andesitic composition. Occasional beds of fine-grained, purple- to buff-colored rhyolitic and dacitic ash occur interspersed among the tuffs. In places, the Fisher Formation forms bold outcrops while, in areas where the ash and finer tuffs have weathered to clay, outcrops are rare and landslides are common. Based upon fossil flora evidence, the Fisher is believed to be late Eocene to Oligocene in age.

2) Eugene Formation

The Fisher strata are succeeded by the Eugene Formation which is composed of a sequence of fossiliferous marine tuffaceous sandstones and siltstones. The sandstone, which is highly arkosic and micaceous, is dark olive to bluish-gray on fresh exposures but weathers to yellowish-brown. In places, the Eugene sediments interfinger with coarser volcanic tuffs. The formation is mid-Oligocene in age as determined from abundant marine fossils. It is exposed within the assessment area only in Secs. 2 and 11, T. 20 S., R. 3 W. and Sec. 6, T. 15 S., R. 2 W.

3) Little Butte Volcanic Series

The Eugene Formation sediments are overlain by a thick succession of volcanic rocks known as the Little Butte Series. The series is a grouping of similar rock types all of which were deposited within the same general span of time. The Little Butte Series was erupted during the Oligocene and early Miocene. The series has not yet been subdivided into formations due to a lack of detailed field mapping and correlation and the limited aerial extent of the many individual flows and pyroclastic deposits.

The most abundant rock type of the Little Butte Series is tuff of dacitic and andesitic composition. Flows of basalt, basaltic andesite, dacite and rhydacite are somewhat less abundant. The Little Butte sequence averages 5,000-10,000 feet in thickness and covers most of the EAR area.

4) Sardine Formation

Flows, tuff breccia, and tuff of hypersthene andesite, basaltic andesite, and augite andesite, and sparse dacite and olivine basalt which have been attributed to the Miocene Sardine Formation are found in the northeast corner of the assessment area. The flows are typically platy and have a porphyritic texture. The tuff is massive and locally abundant. The Sardine Formation averages about 3,000 feet in thickness but, in places, is up to 10,000 feet thick. The Sardine volcanics lie stratigraphically above the Little Butte Series and are younger.

5) Intrusive Igneous Rocks

Dikes, stocks and plugs of igneous rock occur throughout the area. The intrusive bodies range in composition from basalt and gabbro to dacite and, in age, from Eocene to Miocene.

6) Basalt Flows

Numerous flows of basaltic lava overlying the Fisher strata of Oligocene Age are found in the hills to the north and west of Cottage Grove. The rock is predominantly an olivine basalt which commonly shows columnar jointing. Similar flows occur to the east and south of Cottage Grove where they are included in the Little Butte Volcanic Series. The boundary between the Fisher and Little Butte strata has not been clearly defined from Cottage Grove to the south.

7) Alluvial Deposits

Deposits of unconsolidated silt, sand and gravel are found in the valleys of some of the larger streams in the assessment area, including the Calapooya, Row and Coast Fork Willamette Rivers.

b. Structure

The large-scale structure of the Cascade Range in Oregon is that of a broad, north-trending, downwarped pile of volcanic rocks which has been deformed into broad northeast-trending folds and broken by northwesterly-oriented faults. Within the assessment area, all of the geologic units except the alluvium have been deformed by folding. The dips of the strata on the flanks of the folds seldom exceed 20 degrees and most are less than ten degrees. The folding in the Western Cascades took place in several episodes between late Eocene and late Miocene.

The Willamette Valley can be generally described as an eastward-dipping homocline formed between the Coast Range uplift and the Cascade downwarp. The sedimentary strata underlying the alluvium dip eastward beneath the volcanic rocks of the Cascades. Subsurface conditions beneath both the Willamette Valley and the Western Cascades are not well understood at present due to the scarcity of the deep well data.

Few faults have been identified within the assessment area. This probably reflects the lack of good marker horizons and detailed field mapping rather than a general absence of faulting.

c. Economic Geology

1) Minerals

Although the most significant mineral production from lands within the boundaries of this EAR has been crushed quarry rock, other commodities have also been commercially mined. Fire clay is mined periodically from two patented mining claims on Hobart Butte in Sec. 31, T. 22 S., R. 3 W. The Black Butte mercury mine, located on private land in Sec. 16, T. 23 S., R. 3 W., has been inactive since 1969 but was once the largest mercury producer in Oregon.

A number of mineral showings have been reported, particularly in T. 23 S., Rs. 1-4 W. Although a number of mining claims have been located on Federal lands in this area, no commercial production is known to have occurred other than the two mines cited above.

2) Oil and Gas Potential

Western Oregon geology contains all the elements required for the formation, accumulation and entrapment of oil and gas. These elements are: (1) considerable thickness of sedimentary rock deposited in saline water; (2) strata with high organic content associated with reservoir rock; (3) reservoir beds of porous sands; (4) fold and fault structures or stratigraphic closures; and (5) impervious or capping strata overlying reservoir beds.

Western Oregon is similar to oil-producing areas of Southern California in that both have: (1) thick sequences of marine strata which accumulated in deep structural basins in Tertiary time; (2) wide belts of intertonguing nearshore and offshore marine and continental sediments; (3) locally thick sand units that formed along the shorelines of ancient seas; and (4) linear structural belts containing folds and faults that could have formed traps for the retention of petroleum.

Major differences between the two areas are: The lower Tertiary sedimentary sequence of Oregon contains a much greater amount of volcanic material; and many oil seeps, tar pits, bituminous sandstone deposits and other significant surface indications of the presence of oil are found in Southern California but very few are found in

Oregon. At the present time, the only recorded surface indications of oil in the Tertiary marine area of Western Oregon consist of organically rich shales near Newport, Lincoln County, which give off a petroliferous odor when freshly broken and the free oil reported in vesicles and cracks in Eocene basalt near Florence, Lane County.

Gas shows in Oregon are much more numerous and frequently occur with water. Gas shows have occurred in Polk, Columbia, Coos, Douglas, Lincoln, Linn, Multnomah, Tillamook and Washington Counties. Though no commercially viable gas deposits have been found, several farmers are reported to have bubbled off the gas in their water wells and used it for space heating.

No oil or gas wells have been drilled in the past within the EAR area.

The location of oil and gas shows in wells and prospective sedimentary basins in Oregon are shown on Maps 3 and 4.

d. Geologic Hazards

Geologic hazards present in Western Oregon include mass movement of unstable slopes, flooding, seismicity and volcanism.

1) Slope Stability Hazards

Mass soil movements are discussed under Soils (Section II.D.).

2) Flood Hazards

The streams of the Western Cascades generally experience high water conditions several times each year with major flooding occurring less frequently. Winter storms coming inland from the Pacific bring considerable moisture which precipitates in heavy amounts when the air cools as it rises over the Cascades.

Floods on most tributaries to the Willamette are characteristically of short duration, seldom lasting more than five days. Floods on the main streams may last several days. The magnitude of any individual flood is a function of the precipitation intensity, duration of the storm, snow cover, temperatures and degree of saturation of the topsoil. Major floods often result when rapid snow melt combines with heavy precipitation.

Although a number of reservoirs control flooding on most of the major tributaries to the Willamette, widespread inundation and major damage can still occur during major floods such as that which occurred in December 1964. Constriction of waterways by log jams and debris, landfills, piling and structures such as bridges can increase the effects of flooding.

3) Seismic Hazards

Although situated within the circum-Pacific earthquake belt, Oregon has experienced a relatively low level of seismic activity. Fewer earthquake shocks have been recorded in Oregon than in California and Nevada to the south and Washington to the north. Those earthquakes which have been recorded in the State so far have caused only minor damage such as cracked walls, cracked masonry, cracked chimneys, broken lights, broken windows and articles falling from shelves.

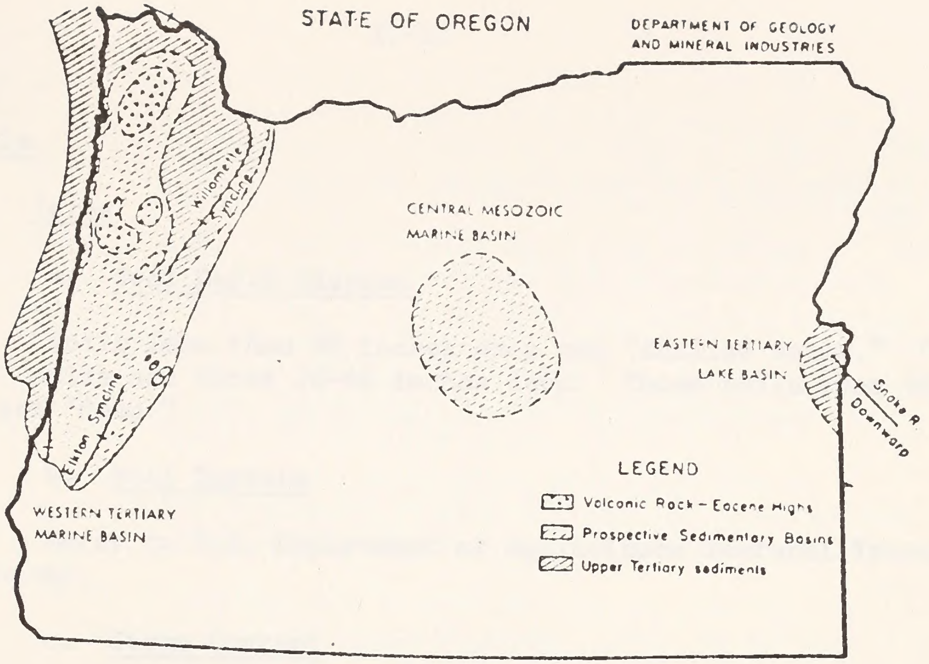
Between 1841 and 1958, approximately 90 noticeable earthquakes occurred in Western Oregon and 73 occurred off the Oregon coast. The average seismic energy released in the Willamette Valley has been estimated to be equivalent to one magnitude 5.3 earthquake on the Richter scale each 30 years. Estimates of the average 100-year seismic energy release in the Cascades are not reliable due to questionable data from the late 1800's. Recent seismic activity has been relatively low.

No earthquake epicenters have been recorded within the assessment area.

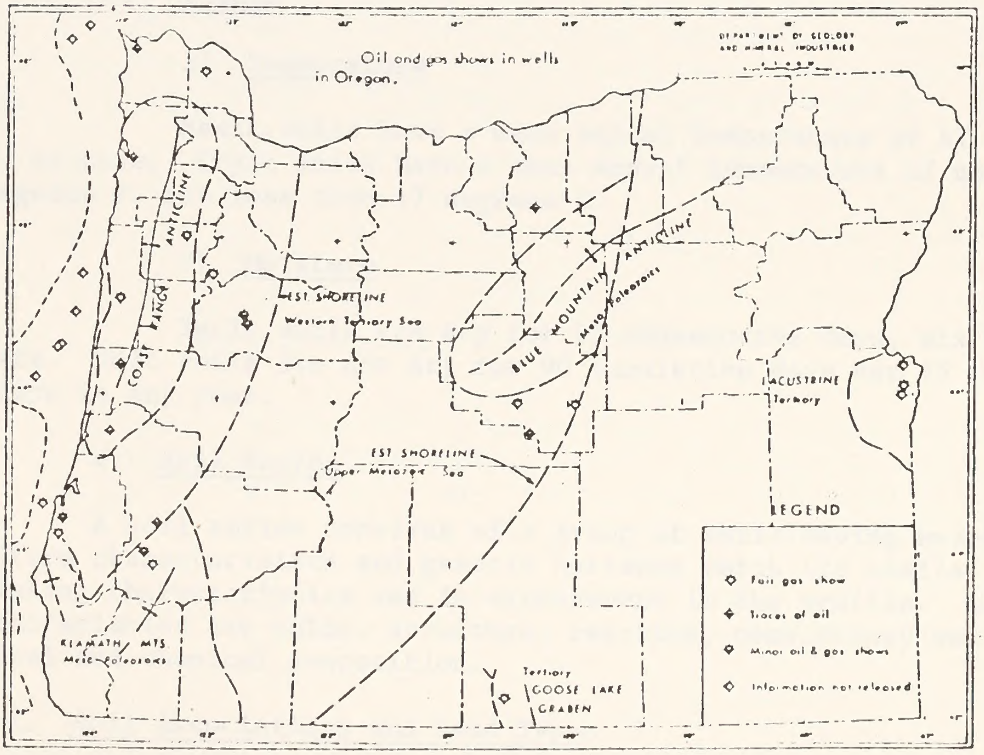
4) Volcanic Hazards

There are, at present, no indications of future volcanic activity in Western Oregon. However, the Cascade Range has been volcanically active in the past so the subject of volcanic hazards cannot be dismissed automatically.

Volcanoes can erupt quickly without extended and obvious warning. Should an eruption occur, it is highly unlikely that it would be located elsewhere than along the volcanic centers of the High Cascades which lie approximately 40 miles east of the assessment area. The only effects that would likely be felt within the assessment area would be earthquakes associated with an eruption and deposition of volcanic ash.


STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
Willamette Syncline
CENTRAL MESOZOIC MARINE BASIN
EASTERN TERTIARY LAKE BASIN
Snake R. Downwarp
Elkton Syncline
WESTERN TERTIARY MARINE BASIN
LEGEND
Volcanic Rock – Eocene Highs
Prospective Sedimentary Basins
Upper Tertiary sediments

Map 3


Oil and gas shows in wells in Oregon.
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
COAST RANGE ANTICLINE
EST SHORELINE
Western Tertiary Sea
BLUE MOUNTAIN ANTICLINE
Meso-Paleozoics
LACUSTRINE Tertiary
EST SHORELINE
Upper Mesozoic Sea
KLAMATH MTS
Meso-Paleozoics
Tertiary
GOOSE LAKE GRABEN
LEGEND
Fair gas show
Traces of oil
Minor oil & gas shows
Information not released

Map 4

D. Soils

1. Terms

a. Soil Depth Classes

Soils less than 20 inches deep are "shallow soils." "Moderately deep" soils are those 20-40 inches deep. Those soils over 40 inches deep are "deep."

b. Soil Texture

Refer to U.S. Department of Agriculture Textural Triangle and soil taxonomy.

c. Stone Content

Soils which contain more than 35 percent coarse fragments by volume are classified as skeletal.

d. Climate

1) Temperature

Mesic soils have a mean annual temperature of 47 degrees F. or more. Cryic soils have a mean annual temperature of more than 32 degrees F. but less than 47 degrees F.

2) Moisture

Xeric soils are dry for 45 consecutive days, six out of ten years. Udic soils are not dry for 90 cumulative days nor 45 consecutive days in any year.

e. Soil Series

A soil series consists of a group of soils having essentially uniform characteristics and genetic horizons which are similar in differentiating characteristics and in arrangement in the profile. Among these characteristics are color, structure, reaction, consistency and mineralogical and chemical composition.

2. Soil Associations and Land Types

The following describes, in general terms, the soil associations and miscellaneous land types found within the assessment area and delineated on Map 5. Pertinent soil properties and qualities and interpretations of soil behavior are listed in Table 2.

The soils in the area vary in depth, texture and stoniness. They occur on topography that ranges from nearly level to very steep, are somewhat poorly drained to excessively drained and are found in different soil temperature and soil moisture regimes.

The soils have been mapped at the series level in the National Soil Classification System which was adopted for general use nationwide by the National Cooperative Soil Survey in 1965 and administered by the Soil Conservation Service, U.S. Department of Agriculture. This system has six categories. Beginning with the broadest, these categories are: order, suborder, great group, subgroup, family and series.

In the following discussion, the major soils are described at the series level but only in brief and general terms because detailed information is available in the Eugene Bureau of Land Management District Office.

a. Mixed Alluvial Land

This mapping unit, a miscellaneous land type, encompasses all the flood plains and alluvial bottom lands which comprise about 9 percent of the mapping area. These areas are dominated by deep, well-drained soils which occupy nearly-level to gently-undulating surfaces and deep, moderately well-drained to poorly-drained soils occurring on nearly-level and depressional areas on floodplains, low terraces and gently sloping fans. Surface textures are predominantly a silty clay or silty clay loam.

The potential limiting factors to use and management on some soils in these locations are excessive wetness (high seasonal water table), flooding, very low permeability and clayey textures.

b. Jory-Bellpine-Ritner Association 2-60 percent slopes

This soil association comprises about 23 percent of the area and occurs on broad, stable, gently sloping convex ridge tops and ridge noses sloping to steep convex sideslopes and gentle to moderately sloping concave foothills. They have formed from colluvium of basic igneous and tuffaceous materials.

The Jory series consists of deep, well-drained soils which have dark reddish-brown, silty clay loam surface layers and dark reddish-brown, silty clay or clay subsoils. These clayey soils comprise about 35 percent of the association.

The Bellpine series consists of moderately deep, well-drained soils which have dark reddish-brown, silty clay loam surface layers and dark red, silty clay or clay subsoils. These clayey soils make up about 30 percent of the association.

The Ritner series consists of moderately deep, well-drained soils which have dark reddish-brown, silty clay loam surface layers and dark reddish-brown, gravelly silty clay loam and dark reddish-brown, very cobbly silty clay subsoils overlying fractured basalt bedrock. These clayey-skeletal soils make up about 20 percent of the association.

The remaining association area is occupied by inclusions of other soils. They being the shallow, well-drained, loamy-skeletal Witzel soils; the moderately deep, well-drained, clayey Nekia soils; and the deep, well-drained, clayey, Willakenzie soils.

c. Nekia-Witzel-Dixonville Association
20-60 percent slopes

This soil association comprises about two percent of the area and occurs on gentle to steep mountainous slopes in the Xeric-Mesic zone.

The Nekia series consists of moderately deep, well-drained soils which have dark reddish-brown, silty clay loam surface layers and dark reddish-brown, silty clay or clay subsoils. They comprise about 40 percent of the association.

The Witzel series consists of shallow, well-drained soils which have a dark brown, very cobbly silt loam surface layer and a dark brown, very cobbly silty clay loam subsoil. These make up about 30 percent of the association.

The Dixonville series consists of moderately deep, well-drained soils which have a very dark brown, silty clay loam surface layer and a dark reddish-brown, clay or silty clay subsoil. These soils make up about 20 percent of the association.

Inclusions of shallow, well-drained, clayey (montmorillonitic) Philomath soils; moderately deep, well-drained, clayey Bellpine soils; and the moderately deep, clayey-skeletal Ritner soils are found intermingled with this association.

d. Peavine-Klickitat-Cumley Association
10-60 percent slopes

This soil association comprises about 17 percent of the area and occurs on gentle to steep mountainous slopes in the Udic-Mesic zone.

The Peavine series consists of moderately deep, well-drained soils which have dark brown, silty clay loam surface layers and dark reddish-brown and yellowish-red, silty clay subsoils. These soils make up about 35 percent of the association.

The Klickitat series consists of deep, well-drained soils which have a dark reddish-brown, gravelly clay loam surface layer. A dark reddish-brown, very gravelly clay loam subsoil and a dark brown, very gravelly loam substratum overlying fractured basalt bedrock. These soils make up about 30 percent of the association.

The Cumley series consists of deep, moderately well-drained soils which have a dark brown, silty clay loam surface layer, a reddish-brown and brown, silty clay and clay subsoil and a substratum of olive brown clay several feet thick overlying weathered tuffs and breccias. These soils make up about 20 percent of the association.

Inclusions of deep, well-drained, fine-textured McCully soils and the deep, well-drained clayey Honeygrove soils are found on the broad ridges and gentle, smooth, even sideslopes. The deep, well-drained, fine-loamy Kinney soils and the shallow, well or excessively well-drained, loamy-skeletal Kilchis soils, found on sharp ridge tops and steep escarpments make up the remaining portion of the association area.

e. Honeygrove-Peavine-McCully Association 2-60 percent slopes

This soil association comprises about 21 percent of the area and occurs on broad, stable convex ridges, ridge noses, saddle positions and on gently sloping to steep sideslopes in the Udic-Mesic zone.

The Honeygrove series consists of deep, well-drained soils which have dark reddish-brown, clay surface layers and dark red, clayey subsoils. These soils make up about 40 percent of the association.

The Peavine series consists of moderately deep, well-drained soils which have dark brown, silty clay loam surface layers and dark reddish-brown and yellowish-red, silty clay subsoils. These soils make up about 35 percent of the association.

The McCully series consists of deep, well-drained soils which have a dark reddish-brown, clay loam and a dark reddish-brown, clay subsoil. These soils make up about 20 percent of the association.

The remaining percentage of the area is occupied by inclusions of the deep, moderately well-drained, clayey Cumley soils found on the gentle footslopes.

f. Klickitat-Kilchis-Bohannon Association 30-75 percent slopes

This soil association comprises about 23 percent of the area and occurs on moderately steep to steep dissected sideslopes, narrow ridge tops and escarpments in the Udic-Mesic zone.

The Klickitat series consists of deep, well-drained soils which have a dark reddish-brown, gravelly clay loam surface layer, a dark reddish-brown, very gravelly clay loam subsoil and a dark brown, very gravelly loam substratum overlying fractured basalt bedrock. These soils make up about 60 percent of the association.

The Kilchis series consists of shallow, well-drained soils which have a dark reddish-brown, gravelly or cobbly loam surface layer and a dark reddish-brown, very gravelly silt loam subsoil overlying fractured basalt bedrock. These soils make up about 30 percent of the association.

The Bohannon series consists of moderately deep, well-drained soils which have a dark brown, gravelly surface layer and a dark brown, gravelly or cobbly loam subsoil overlying fractured pyroclastic or basalt bedrock. These soils make up about 80 percent of the association.

Intermingled rock outcrop is found at random throughout the area and inclusions of moderately deep, well-drained, clayey Peavine soils are found on benches, rounded ridge tops and moderately steep, smooth sideslopes.

g. Kinney-Bohannon-Klickitat Association
20-70 percent slopes

This soil association comprises about one percent of the area and occurs on smooth to dissected slopes in the Udic-Mesic zone.

The Kinney series consists of deep, well-drained soils which have a very dark brown, cobbly loam surface layer, a dark brown, cobbly clay loam subsoil and a dark brown, cobbly loam substratum overlying weathered pyroclastic or basalt bedrock. These soils make up about 40 percent of the area.

The Bohannon series consists of moderately deep, well-drained soils which have a dark brown, gravelly surface layer and a dark brown, gravelly or cobbly loam subsoil overlying fractured pyroclastic or basalt bedrock. These soils make up about 30 percent of the area.

The Klickitat series consists of deep, well-drained soils which have a dark reddish-brown, gravelly clay loam surface layer, a dark reddish-brown, very gravelly loam subsoil and a dark brown, very gravelly loam substratum overlying fractured basalt bedrock. These soils make up about 20 percent of the association.

The remaining portion of the association area is occupied by inclusions of the moderately deep, well-drained, clayey Peavine soils and the deep, well-drained, fined-textured McCully soils found on the broader ridges and saddles while the shallow, well-drained, loamy-skeletal Kilchis soils are found on the steep upper convex sideslopes and escarpments.

h. Holderman-Winberry-Keel Association 10-90 percent slopes

This soil association comprises about five percent of the area and occurs on gently sloping to steep slopes and sharp ridge tops in the Cryic zone.

The Holderman series consists of moderately deep, well-drained soils which have a dark grayish-brown, gravelly loam surface layer and a dark brown, very gravelly loam subsoil overlying partially-weathered andesite, tuffs or breccias. These soils make up about 40 percent of the association.

The Winberry series consists of shallow, somewhat excessively-drained soils with a very dark grayish-brown, very gravelly surface layer and a brown, very cobbly loam overlying partially-fractured bedrock. These soils make up about 30 percent of the association.

The Keel series consists of moderately deep, well-drained soils which have very dark brown and very dark grayish-brown, gravelly loam and silt loam surface layers and dark brown, silt loam to cobbly clay loam subsoils overlying fractured rock. These soils make up about 20 percent of this association.

Inclusions of deep, well-drained, reddish-brown, gravelly loam and gravelly clay loam Cruiser soils make up a large portion of the remaining association area.

i. Hummington-Keel-Cruiser Association 2-80 percent slopes

This soil association comprises less than one percent of the area and occurs on broad, sloping ridge tops with gradients from 2-30 percent and on smooth or dissected slopes with gradients ranging from 30-80 percent. These soils have a short growing season and are found at elevations above 2,800 feet. They are in the Cryic zone.

The Hummington series consists of moderately deep, well-drained soils and have a very dark brown and very dark grayish-brown, gravelly loam surface layer and dark brown, gravelly loam and very cobbly loam subsoils overlying basic intrusive igneous rock. These soils make up about 50 percent of this association.

The Keel series consists of moderately deep, well-drained soils which have very dark brown and very dark grayish-brown, gravelly loam and silt loam surface layers and dark brown, silt loam to cobbly clay loam subsoils overlying fractured igneous bedrock. These soils make up about 30 percent of the association.

The Cruiser series consists of deep, well-drained soils which have dark brown or dark reddish-brown, gravelly loam surface layers and reddish-brown or yellowish-red, gravelly clay loam subsoils. These soils make up about 20 percent of the association.

3. Surface Erosion

Surface erosion, particularly rate and severity, is difficult to quantify. Rainfall intensity and duration, percent and length of slope, soil particle size distribution, soil structure and permeability, land use and vegetative cover are all significant factors in determining a soil's potential "erosion hazard." These factors may operate independently or in concert to either lessen or increase this erosion potential. Although erosion rates vary in relation to these many site factors, it is minimal on undisturbed forest land. This is largely attributable to the great value vegetative cover and forest floor litter have in reducing surface runoff and resulting soil particle detachment and transport. Removal of vegetative cover and destruction of the litter layers which play such an extremely important role in absorption of precipitation and moderation of runoff, on the other hand, will lead to an increase in surface erosion.

The soils have been qualitatively placed, as shown in Table 2, in erosion hazard classes according to their tendency to have particles detached and transported by raindrop impact and surface runoff under bare soil conditions. The response tendency is based upon slope steepness, soil characteristics and rainfall (amount and intensity). These hazard classes are described as follows:

a. A low potential-hazard rating indicates that insignificant soil loss is anticipated.

b. A medium potential-hazard rating indicates some precautions are needed to prevent appreciable soil loss.

c. A high potential-hazard rating indicates that special management practices or treatments should be planned to minimize a severe soil loss.

4. Mass Soil Movement (Landslides)

This phenomenon is the dominant erosion process in the area. It involves the interaction of slope gradient, bedrock, ground water, soil depth and other soil physical properties.

Road building and timber cutting are effective initiators of slope failures.

The landslide types most commonly observed in the area are debris avalanche, debris flows, slumps and mudflows. Debris avalanche and debris flows are often initiated by failure of uncompacted, saturated fill embankments and debris-choked drainageways in steep headwalls where shallow and moderately deep, loamy-skeletal Kilchis and Klickitat soils have developed from colluvium derived from basaltic andesite, basalt flows, andesitic lapilli tuffs, conglomerate and agglomerate. Slumps usually occur in deep, fine-textured McCully soils and clayey-textured Panther and Hazelair soils which have high expanding montmorillinitic clays, a high seasonal water table and are somewhat poorly drained.

An inventory has shown that slope failures with basalt substratum failed on the steeper and higher physiographic positions on the landscape. Average slopes were 55 percent and elevations greater than 2,100 feet. Failures with andesite tuffs and breccias as substratum occurred on slopes of comparative steepness and elevations, 47 percent and 1,300 feet respectively. Failures with saprolitic substratum occurred on slopes and elevations averaging ten percent and 1,000 feet, respectively. Also, of the total slide events, 59 percent occurred on slopes equal to or greater than 45 percent.

A comparison with landslide events occurring in the bedded sediments of the Coast Range physiographic province and the basalts and pyroclastics of this portion of the Western Cascade Province identifies the greater influence of ground water in slope failures in this area. For example, 73 percent of the slope failure on bedded sediments occurred on slopes greater than 60 percent while only 23 percent here failed on slopes less than 60 percent. So, recognizing the extremely important role of ground water in initiating slope failures and findings that show 78 percent of the total slope failures originate from cut slopes, in turn, identifies the need for use of rock buttresses and riprap as toe slope support and improved drainage through special use of horizontal drains, perforated pipe and diversion ditches as stabilizing measures.

The soils have been given a landslide hazard rating in Table 2 but, for more detailed information, specific reports are available in the Eugene District Office.

See Map 6, entitled Erosion and Landslide Hazard, which delineates areas with defined erosion hazards and unstable slopes.

TABLE 2

PROPERTIES, QUALITIES AND INTERPRETATIONS OF MAJOR SOIL SERIES

Soil Series	Soil Depth* (Inches)	Hydro-logic Group	Permeability** (Inches/Hour)	Unified Class. (Subsoil)	Landslide Hazard***		Erosion Hazard †			Compaction †† Hazard	Site Index ††† (Douglas-fir)
					35-60% Slope	60+% Slope	35-% Slope	35-60% Slope	60+% Slope		
Bellpine	20-40	C	0.06-0.20	MH	mod. stable	unstable	med.	high	high	high	140
Bohannon	20-40	B	2.00-6.00	SM	stable	mod. stable	low	med.	high	med.	145
Cumley	40-60+	C	0.20-0.63	MH	--	--	med.	--	--	high	155
Cruiser	20-40	B	0.60-2.00	ML	stable	mod. stable	low	med.	high	low	135
Dixonville	20-40	C	0.06-0.20	CH	mod. stable	unstable	med.	high	high	high	120
Hazelair	24-40 (to dense clay) (15-30)	D	0.06-0.20	CH	unstable	unstable	high	high	high	high	120
Holderman	20-40	C	2.00-6.00	GM	stable	stable	low	med.	high	low	135
Honeygrove	40-60+	C	0.14-0.16	MH	mod. stable	unstable	med.	high	high	high	165
Hummington	20-40	C	2.00-6.00	GM	stable	mod. stable	low	med.	high	low	130
Jory	40-60+	C	0.20-0.60	CL	mod. stable	unstable	med.	high	high	high	160
Keel	20-40	C	0.60-2.00	GM	stable	mod. stable	low	med.	high	low	130
Kilchis	12-20	C	2.00-6.00	GM	stable	mod. stable	low	med.	high	low	115
Kinney	40-60+	B	0.60-2.00	MH	stable	mod. stable	low	med.	high	med.	150
Klickitat	40-60+	B	0.60-2.00	GC	stable	mod. stable	low	med.	high	low	142
Nekia	20-40	C	0.20-0.60	CL	mod. stable	unstable	med.	high	high	high	135
Peavine	20-40	C	0.20-0.60	MH	mod. stable	unstable	med.	high	high	high	145
Philomath	12-20	D	0.06-0.20	CH	unstable	unstable	med.	high	high	high	--
Ritner	20-40	C	0.20-0.60	GC	mod. stable	unstable	low	high	high	med.	136
Willakenzie	40-60+	C	0.20-0.60	CL	mod. stable	unstable	med.	high	high	high	155
Winberry	10-20	C	2.00-6.00	GM	stable	stable	low	med.	high	low	90
Witzel	10-20	D	0.20-0.60	GC	stable	mod. stable	low	high	high	low	95

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* Depth is to bedrock except as noted. Restrictions to rooting, other than water table, and the depths to them are shown in parentheses.

** Rates are for least permeable layer.

*** Hazard ratings based on field observations as to tendency to slump or slide when associated with road construction and denudation of slopes.

† Based on bare soil surface.

†† Based on reduction of pore space which impedes root development and air and water movement.

††† Approximate medium value of plot data based on USDA, 1949, Technical Bulletin No. 201.

E. Vegetation

1. Terrestrial

The public lands within the assessment area are dominated almost entirely by coniferous forests typical of the Western Hemlock (Tsuga heterophylla) Forest Zone. It is emphasized that, although this is called the Western Hemlock Zone, based on the potential climax species, large areas are dominated by forests of Douglas-fir. The Pacific Silver Fir (Abies amabilis) Forest Zone is also present at high elevations in a few localities. Of the approximately 85,000 acres of public land, only about 650 acres scattered in small patches, are classified as nonforest.

The most common tree species are Douglas-fir (Pseudotsuga menziesii), western hemlock and western redcedar (Thuja plicata). Occurring sporadically as individuals or in small groups are grand fir (Abies grandis), sugar pine (Pinus lambertiana), western white pine (Pinus monticola), ponderosa pine (Pinus ponderosa) and incense-cedar (Libocedrus decurrens). Hardwoods other than as scattered individuals are not a usual component of the forest stand except on areas recently logged or burned or on more specialized sites. For example, bigleaf maple (Acer macrophyllum) and red alder (Alnus rubra), the most common hardwoods, and black cottonwood (Populus trichocarpa), occur in patches along wetter, streamside locations. Oregon ash (Fraxinus latifolia) is found in the forested swamps where there is a high water table or even standing surface water for all or even a portion of the year. Golden chinquapin (Castanopsis chrysophylla), Pacific madrone (Arbutus menziesii), Oregon white oak (Quercus garryana) and canyon live oak (Quercus chrysolepis) are found on the drier, more stressful sites. Pacific yew (Taxus brevifolia) is a common understory tree throughout the area. Occasionally, other species of trees are also encountered but they are not of commercial importance in this area.

The Pacific Silver Fir Zone usually consists of a nearly pure stand of these trees with very little understory vegetation.

Dominance and density of individual species vary with differences in elevation, moisture, exposure, soil fertility, etc.

The foregoing describes the typical forest stand dominated by tree species in the more advanced stages of vegetative succession. However, throughout the unit are found areas denuded of mature trees as the result of logging or wildfire. The vegetative composition on these areas is different from a typical forest stand and represents the earlier stages of succession. Though innumerable combinations of time, moisture and applied management practices will have influenced the vegetation on a particular site, these denuded areas as a group can be classified into two general categories.

a. Sites with low moisture regimes are usually invaded by herbaceous species. After three or four years, woody shrub species begin to dominate. The more common shrubs include oceanspray (Holodiscus discolor), California hazel (Corylus cornuta californica), salal (Gaultheria shallon), Pacific rhododendron (Rhododendron macrophyllum) and snowbrush (Ceanothus velutinus). These woody species are often dominant early after harvest or fire if the former stand of trees had a relatively open canopy.

b. Sites with higher mosture regimes are characteristically dominated by moisture-loving species commonly associated with the original forest stand. If the previous stand had a closed canopy, the area will tend to be dominated by herbaceous species such as swordfern, twinflower, Oregon oxalis, etc. If the canopy was relatively open, the vegetation will consist of the above herbs together with woody plants such as red alder, bigleaf maple, vine maple (Acer circinatum), western hemlock, salmonberry (Rubus spectabilis), thimbleberry (Rubus parviflorus) and red huckleberry (Vaccinium parvifolium).

Obviously, these two general categories do not include all plants that may be found in any given area. Many additional species may be found sporadically or even in abundance under specific conditions.

Poisonous and noxious plants are abundant from a clinical standpoint but two species, poison oak and tansy ragwort, have significant economic importance.

c. Pacific poison oak (Rhus diversiloba) is a woody, vine-like plant abundantly common on drier south and west exposures throughout Western Oregon. Its oily secretions cause a severe, itching rash which is considered an "occupational hazard" among foresters and loggers.

d. Tansy ragwort (Sencio jacobaea) is becoming a major agricultural problem as it continues to spread over cutover forest lands and hill pastures. Over 500,000 acres of Western Oregon have been infested with the weed since its introduction about 50 years ago. Tansy is a poisonous plant which causes production loss, severe liver damage and death among several domestic animal species. Cattle and horses are most commonly affected with verified cases of poisoning among swine and sheep. Newly-logged areas and recently-disturbed soil from road construction are prime locations for infestation. Once introduced, an abundant seed source is established which economically defies traditional methods of control - herbicide and cultivation. Without a practical control, surrounding agricultural lands are subject to continual reinfestations. Several biological controls are in the testing stage but a definitive evaluation will require several more years.

2. Aquatic

With the exception of seasonal swamps and ponds, the aquatic environment within the assessment area is a running (lotic) or stream type as opposed to a standing type. Thus, current, cooler water, lower nutrient content and less available sunlight limit aquatic vegetation to willows, filamentous algae and periphyton. The totality of the vegetative component of the aquatic environment is comprised of more than just submersed vegetation; terrestrial plants are a crucial link. The typical fauna of the lotic system are "debris" feeders, highly dependent upon organic materials which drop into the stream from adjacent vegetation.

3. Rare or Endangered

The lands surrounding Eugene are suspected to contain a number of plant species which are endangered, threatened and/or rare. Approximately 20 species so classified may be located. Field examination to date has been minimal and two species have been found. A check of herbarium material at both the University of Oregon and Oregon State University failed to disclose any specific locations on BLM-administered lands in the Eugene District.

Plants on the U.S. Fish and Wildlife Service list of endangered plants published in the Federal Register, June 16, 1976 (Vol. 41, No. 117, pages 24524-24572), are Bradshaw's lomatium (Lomatium bradshawii) and Nelson's sidalcea (Sidalcea nelsoniana).

Additional plants on the "Smithsonian Institution Report on Endangered and Threatened Plant Species of the United States," January 1975, are: white-top aster (Aster curtus), wayside aster (Aster vialis), green-fruited sedge (Carex interrupta), pine-foot (Pityopus californicus), Cascadian knotweed (Polygonum cascadense) and giant fawn-lily (Erythronium oregonum).

Plants on the "Provisional List of Rare, Threatened and Endangered Plants in Oregon," by Jean L. Siddal, January 1977, are tall agoseris (Agoseris elata), Cascade daisy (Erigeron cascadensis), meadow erigeron (Erigeron decumbens), large round-leaved rein-orchid (Habenaria orbiculata), sulfur-flowered lupine (Lupinus sulphureus var. kincaidii), timwort (Microcala quadrangularis), fringed-pinesap (Pleuricospora fimbriolata), Sierra wood-fern (Theypteris nevadensis), scalloped onion (allium crenulatum) and tufted saxifrage (Saxifraga caespitosa).

F. Fisheries

The general distribution of cold water salmonid species in the assessment area is shown on Map 7. Approximate upstream limits are included for chinook salmon, coho salmon, steelhead, rainbow trout and cutthroat trout. Crucial habitat includes the reservoirs which provide rearing and streams used by salmon and steelhead or which are valuable as potential for anadromous fish migration, spawning or rearing.

Additional fish species present are included in Table 3. Table 4 indicates the relative value of fish habitat and primary types of use by salmonids in streams involved. The Oregon Department of Fish and Wildlife provided information in Table 5 relative to periods when salmon, steelhead and trout are present in streams. The Department also provided sections in the narrative on fish spawning, rearing and passage.

1. Aquatic Life

a. Chinook Salmon

Chinook salmon depend on spawning gravel and rearing pools mainly in the larger streams since they do not normally migrate up the small tributaries. Both spring and fall chinook occur, although several of the larger streams have excessive summer water temperatures resulting in inadequate habitat for very many spring chinook which rear in streams throughout the summer.

Spring chinook have been stocked in Cottage Grove Reservoir for rearing and adult chinook were previously trucked above Fall Creek Reservoir. Land-locked chinook also are present in Lookout Point Reservoir. All of the dams in the area are barriers to upstream migration of anadromous fish.

In addition to locations directly involved, many chinook occur downstream in Middle Fork Willamette River and the McKenzie River. Some chinook also are present in lower Mohawk River.

b. Coho Salmon

Coho salmon use the larger streams mainly for migration while the medium-size and relatively small tributaries provide spawning habitat. Rearing occurs in these streams except where water temperatures are too high. Stream siltation and washouts also have caused considerable damage to their habitat.

Coho have been becoming established in the Upper Willamette drainage by stocking although significant population fluctuations have occurred. Coho have returned to spawn and rear in tributaries of the

Mohawk River, Little Fall Creek and Mosby Creek. None of these streams have major obstructions to anadromous fish passage. Potential habitat for coho spawning and rearing also is available upstream from all reservoirs in the area.

c. Steelhead

Steelhead are rainbow trout which migrate to the ocean. Use of streams by steelhead is similar to coho although some variations occur, including the apparent use of more streams for spawning and rearing. Primarily, winter steelhead are present but the McKenzie River also contains summer steelhead which are becoming established by stocking.

The Calapooya River and Fall Creek are important streams for steelhead migration and spawning. Steelhead are trucked above Fall Creek Reservoir for upstream spawning and rearing in Fall Creek.

d. Trout

Trout in the area include rainbow and cutthroat. Rainbow trout are present in the larger streams, some of their tributaries and the reservoirs. These reservoirs and essentially all perennial streams are used by cutthroat except where stream gradients are too steep or high falls have stopped upstream migration.

Streams that are at least marginal for trout generally are considered Class I habitat based on the Oregon stream classification system. Some of the best trout streams are located upstream from the reservoirs.

e. Other Game Fish

Other game fish are also available in the assessment area. Largemouth bass and bullhead catfish inhabit primarily the larger streams, Dorena Reservoir and Cottage Grove Reservoir. Additional species found in some of the larger streams include whitefish, smallmouth bass, bluegills and crappies.

f. Nongame Fish

Nongame fish include lampreys, cottids, dace, shiners, squawfish and suckers. Some of these fish occur in the larger streams while others are found in essentially all drainages. Considerable competition exists between game fish and nongame species.

g. Other Aquatic Animals

Other aquatic animals include crayfish and insects which have value as food for fish. Primary insects found in streams with high water quality are mayflies, stoneflies and caddisflies.

2. Fishing

Streams in the Upper Willamette drainage are valuable for the production of salmon that are caught by commercial and sport fishermen. Salmon produced in the area are caught primarily in the ocean and in the Columbia and Willamette Rivers.

Some of the larger streams are important for steelhead fishing. Considerable fishing is done in Dorena Reservoir for trout and warm-water game fish. Valuable habitat for fishing is also available in other reservoirs and various streams.

3. Spawning

Anadromous fish require gravel for spawning. For salmon and steelhead, gravel should range between one-quarter inch and six inches in diameter with extremes in sizes being least desirable. Chinook salmon normally select slightly larger gravel than do coho or steelhead, while trout choose the smaller gravels. Gravel should be relatively free of silt and must not be seriously compacted. Excessive silt in the gravel creates adverse conditions for eggs and fry by causing low intergravel flows at reduced velocities. This results in low supplies of available dissolved oxygen and inhibits the escapement of fry from the gravel. Adequate depth of gravel is necessary for construction of a nest, or redd, by the female fish. Depending on species, redd depths may vary from approximately 6-15 inches.

Suitable water temperatures for spawning range from about 42-53 degrees F. Temperatures outside these limits can cause excessive loss of eggs. Eggs from salmon and steelhead hatch in about two months and fry emerge from the gravel about two weeks later. Incubation time is controlled by prevailing water temperature with less time required at warmer temperatures.

The minimum dissolved oxygen requirement for egg and fry survival is higher (near eight parts per million) than for adult fish (near five parts per million). The greater oxygen demand of eggs and fry is satisfied by good permeability and rate of intergravel flow, both of which are influenced by gravel size, stream gradient and amount of sedimentation.

Proper surface water velocities and depth are necessary to attract spawning fish. Minimum velocity for most salmonids is about one foot per second. Depths required vary with species and individual fish size.

4. Rearing

The most critical time in the fresh-water life of young anadromous fish after hatching is the summer low-flow interval. This is generally referred to as the period of "rearing." Steelhead and cutthroat generally spend two years and spring chinook one year in fresh water before migrating to the ocean. Fall chinook nomally migrate from their parent stream within three months after hatching.

The size and success of an anadromous fish population is largely dependent on certain conditions within the stream during the rearing period. These conditions fall into three main categories:

a. Food

Young salmonids' food during stream residence consists primarily of immature aquatic insects. Production of these organisms is confined almost entirely to riffle areas. The best-producing riffles are those composed of unsilted gravel or rubble and well aerated by clean, flowing water.

b. Shelter

Shelter is any location a fish will remain in or return to when frightened or disturbed. Such places may be found within riffles but are more often associated with deeper pool areas. Shelter is necessary for resting and as a refuge where fish can escape predators.

c. Suitable Medium

Suitable medium refers primarily to water quality requirements. Good rearing water is high in dissolved oxygen (above 5 ppm), low in turbidity, not greatly acid or alkaline and has temperatures not exceeding 65 degrees F. for extended summer intervals.

High water temperatures contribute to fish mortalities by exceeding the tolerances of salmonids. As temperature increases, water loses is capacity to hold dissolved oxygen. Simulateously, the metabolic rate and resultant oxygen demand of cold-blooded animals rises. This causes a condition of greater need with a reduced supply. The incidence of disease also increases with rising temperatures.

Turbid waters generally cause greater damage to fish habitat than to fish themselves, mainly from siltation of food-producing and spawning areas. Heavier silt loads can also drive fish from a stream, impair their health and result in actual mortalities.

Adequate summer flows play a vital part in meeting basic food, shelter and suitable medium requirements. Without an adequate flow, any or all of the necessary conditions may not be satisfied. The elimination of but one factor can be sufficient to severely limit or even destroy a salmonid population.

5. Passage

By definition, anadromous fish migrate between the ocean and fresh water. To do so, they must have enough flow for passage. As upstream migrants, adult salmon, steelhead and trout require a portion of the stream cross section to possess sufficient water depth so passage will not be impeded. Juvenile anadromous fish need adequate water volume for interstream movement during their rearing period and later to support an uninterrupted seaward migration.

TABLE 3
FISH SPECIES

Species	General Distribution
Chinook salmon	Large streams, main tributaries, Lookout Point and Cottage Grove Reservoirs
Coho salmon	Large streams and tributaries except above reservoirs
Steelhead	Large streams, tributaries, Fall Creek Reservoir and Fall Creek upstream from reservoir
Rainbow trout	Large streams, tributaries and reservoirs
Cutthroat trout	All drainages and reservoirs
Whitefish	Large streams and main tributaries
Largemouth bass	Large streams at low elevations and Dorena and Cottage Grove Reservoirs
Smallmouth bass	Coast Fork Willamette River
Bluegill	Large streams at low elevations
Bullhead catfish	Large streams at low elevations and Dorena and Cottage Grove Reservoirs
Crappie	Large streams at low elevations
Lamprey	All drainages
Cottid	All drainages
Dace	All drainages
Shiner	Various streams at low elevations
Squawfish	Large streams at low elevations
Sucker	Large streams at low elevations

TABLE 4
FISH HABITAT

Stream	Relative Value	Primary Types of Fish Use		
		Migration	Spawning	Rearing
Cst. Fk. Willamette R.		X	X	
Below Reservoir	Fair to Good			
Above Reservoir	Good to Excellent			
Row River		X	X	
Below Reservoir	Fair to Good			
Above Reservoir	Good			
Big River	Good to Excellent		X	X
Mosby Creek	Fair to Good	X	X	
Sharps Creek	Good to Excellent		X	X
Calapooya River	Good to Excellent	X	X	
Mohawk River	Good	X	X	
Fall Creek	Excellent	X	X	
Little Fall Creek	Good to Excellent	X	X	
Winberry Creek	Fair to Good		X	X
Lost Creek	Fair to Good		X	X
Other Streams Within Area	Marginal to Good (Generally)		X	X

TABLE 5

Periodicity Chart Showing When Adult Fish are Present or Spawning in Upper Willamette Streams

Species	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June
Spring chinook*	......	......	------	----xxx	xxxxxxx	xxxxxxx	xxxxxxx			....	......	......
Fall chinook			...	...---	-------	----xxx	xxxxxxx	xxxxxxx	xxxxx			
Coho salmon*			...	....	------	------	---xxx	xxxxxxx	xxxxxxx	xxx		
Rainbow trout (resident)	......	......	......	......	......	......	......	------	------	--xxxx	xxxxxxx	xxxxxx
Cutthroat trout	xxx...	......	......	......	......	......	------	------	------	------	---xxx	xxxxxx
Winter steelhead*	xxxxxx	xxxxxxx	......	......	......	......	......	......	....--	------	------	--xxx
Summer steelhead*	xxxxxx	xxxx...	......	......	......	......	......	......	....--	------	------	--xxx

.... Adults present in streams
------- Periods of heaviest spawning
xxxxxxx Periods after spawning when eggs and fry are still in gravel

* Juveniles rear one or more years in fresh water prior to seaward migration

G. Wildlife

The following is an inventory of Eugene District wildlife species grouped according to basic habitat requirements. Included are those mammals, birds, reptiles and amphibians known or believed to reproduce on BLM land within the District boundaries. The Peregrine falcon, marten and fisher are listed because of their recent historical records. It is doubtful that these species now reproduce in the EAR area.

1. Life Forms

a. Some or all life needs obtained in trees of old-growth, coniferous forests; large, dominant trees in younger conifer forests; or snags and decadent or dying trees over eight inches dbh in all habitats:

1) Nests, forages and finds cover primarily in old-growth, coniferous forests. Feeds primarily on small mammals: Northern spotted owl.

2) Nests in large, dominant conifers or snags. Forages in open country, on ground or in water. Feeds primarily on small mammals or fish: Bald eagle, golden eagle, red-tailed hawk, osprey.

3) Constructs nest cavities in snags or dying trees. Feeds in trees or on ground, primarily on insects or seeds and nuts: Pileated woodpecker, hairy woodpecker, downy woodpecker, acorn woodpecker, common flicker, yellow-bellied sapsucker.

4) Nests in decadent or hollow trees, often in cavities constructed by woodpeckers:

a) Feeds in water, primarily on fish or plant material: American merganser, hooded merganser, wood duck.

b) Feeds in air or on ground on large insects or small birds and mammals: American kestrel, screech owl, pygmy owl, saw-whet owl, barn owl.

c) Feeds in bushes and trees primarily on seeds or nonflying insects: Black-capped chickadee, chestnut-backed chickadee, red-breasted nuthatch, white-breasted nuthatch, western bluebird, house wren, Bewick's wren, mountain bluebird.

d) Feeds in air, often over water, on flying insects: Violet-green swallow, tree swallow, purple marten, Vaux's swift, little brown myotis, California myotis, long-legged myotis, long-eared myotis, Yuma myotis, silver-haired bat, hoary bat, big brown bat.

e) Nests under loose bark and feeds on insects: Brown creeper.

f) Nests in cavity or constructed nest on limb. Forages in trees or on ground. Feeds on plant material or is carnivorous: Northern flying squirrel, Douglas squirrel, red tree vole, marten, fisher.

b. Nests in trees of young to mature coniferous forests. Forages on ground, in air, bushes or trees in a variety of habitats:

1) Feeds on birds or small mammals: Goshawk, Cooper's hawk, sharp-shinned hawk, great horned owl.

2) Feeds in air on flying insects: Western flycatcher, olive-sided flycatcher.

3) Feeds primarily on nonflying insects and berries: Golden-crowned kinglet, ruby-crowned kinglet, yellow-rumped warbler, hermit warbler, western tanager.

4) Feeds primarily on seeds, nuts and berries: Evening grosbeak, pine siskin, red crossbill, bandtailed pigeon.

5) Feeds on wide variety of foods, including carrion: Gray jay, Stellar's jay, common raven, common crow.

c. Nests in bushes or small trees (conifer or hardwood) of understory of conifer forest, in shrub-sapling, hardwood and riparian habitats or where these habitats form edge with conifer forest:

1) Feeds in air on flying insects: Western kingbird, willow flycatcher, dusky flycatcher, western wood pewee.

2) Feeds on berries and nonflying insects: Robin, varied thrush, hermit thrush, Swainson's thrush, cedar waxwing, solitary vireo, red-eyed vireo, Hutton's vireo, warbling vireo, rufus hummingbird, calliope hummingbird, orange-crowned warbler, Nashville warbler, yellow warbler, black-throated gray warbler, McGillivray's warbler, Wilson's warbler, yellow-breasted chat, northern oriole, bush tit, Townsend's solitaire.

3) Feeds primarily on seeds or wide variety of foods: Western gray squirrel, scrub jay, mourning dove, black-headed cowbird, black-headed grosbeak, Lazuli bunting, purple finch, American goldfinch, lesser goldfinch, chipping sparrow, song sparrow, fox sparrow.

d. Life needs dependent primarily on aquatic or riparian habitat:

1) Nests in colony in large conifers or hardwoods. Feeds on variety of aquatic and riparian organisms: Great blue heron.

2) Nests in marsh vegetation or in shrub or small tree adjacent to quiet or slow-moving water. Feeds on variety of aquatic and riparian organisms: Green heron, long-billed marsh wren.

3) Constructs tunnels in banks or houses in water. Feeds on herbaceous or woody vegetation: Beaver, muskrat, nutria, white-footed vole.

4) Nests or dens primarily in natural cavities in ground or hollow trees, in debris or enlarged burrows of other animals: Raccoon, mink, river otter, water shrew.

5) Spawns in aquatic habitats, forages in aquatic or terrestrial habitats. Mobility is relatively low:

a) Spawns or breeds in aquatic habitats but found in debris or dense vegetation on moist terrestrial habitats during adult or subadult stages: Northwestern salamander (warm water), long-toed salamander (warm water), Pacific giant salamander (cold water), rough-skinned newt, red-legged frog, Pacific tree frog.

b) Completes entire life cycle in cold aquatic or riparian habitat: Olympic salamander, tailed frog, Cascade foothill yellow-legged frog.

c) Completes entire life cycle in warm aquatic and riparian habitat: Bullfrog, western pond turtle, spotted frog.

6) Nests on ground, rock ledge or in short burrow. Forages in or over riparian and aquatic habitats: Mallard, spotted sandpiper, belted kingfisher, dipper, bank swallow.

e. Life needs met primarily on ground in variety of terrestrial habitats:

1) Constructs burrows or nests in debris. Forages above or below ground primarily on insects or plant material; relatively small animals with low mobility:

a) Constructs extensive burrow system for nesting and cover. Feeds above ground on herbaceous or woody vegetation: Mountain beaver, Beechey's ground squirrel, pocket gopher, Townsend's chipmunk.

b) Constructs extensive burrow in soil for nesting and foraging or forages in shallow tunnel in light debris and nests in debris or shallow burrow: Townsend mole, coast mole, shrew mole.

c) Nests in debris, forages in debris or dense vegetation, often on moist sites. Feeds primarily on insects: Dusky shrew, Pacific shrew, vagrant shrew, Trowbridge shrew, marsh shrew.

2) Nests on ground in dense vegetation, under debris or in burrows constructed by other animals; relatively small animals with low mobility:

a) Limited to or prefers damp sites with abundant debris or ground vegetation, often near water; carnivorous (in at least adult stages): Dunn's salamander, western red-backed salamander, Oregon slender salamander, clouded salamander, Oregon salamander (only in Cascades), western toad, northern alligator lizard, northwestern garter snake, common garter snake, western terrestrial garter snake.

b) Limited to or prefers warm, dry sites with debris, rock or burrows and vegetation for cover; carnivorous: Western fence lizard, western skink, southern alligator lizard, western rattlesnake.

c) Found in variety of habitats; mostly vegetarian or insectivorous: Porcupine, snowshoe hare, brush rabbit, deer mouse, Pacific jumping mouse, Pacific phenacomys, California red-back vole (strictly coniferous forest), Townsend mole, longtail vole, Oregon vole, bushytail woodrat, dusky-footed woodrat.

3) Utilizes coniferous forest stands (7+ inches dbh) for thermal cover. Forages extensively on herbaceous and woody vegetation in meadows, grass-forb, shrub-sapling and riparian habitats. Large animals with high mobility: Roosevelt elk, blacktail deer.

4) Nests or dens in natural cavity on ground under debris, in dense vegetation, enlarges burrow of other animals or occasionally constructs own burrow. Forages on ground; carnivorous or omnivorous. Found in variety of habitats: Turkey vulture, black bear, short-tailed weasel, long-tailed weasel, spotted skunk, striped skunk, bobcat, cougar, coyote, gray fox, red fox.

5) Nests on or close to ground. Forages on ground or in bushes and small trees. Feeds on insects, berries, seeds and vegetative buds: Valley quail, mountain quail, ruffed grouse, blue grouse, dark-eyed junco, winter wren, wren-tit.

6) Nests on bare, flat ground in open. Forages in air on flying insects: Common nighthawk.

f. Life needs dependent upon cliffs, rock outcrops or talus slopes:

1) Nests on exposed cliffs near aquatic habitat. Feeds in air on flying insects: Cliff swallow.

2) Nests and forages in exposed rocky areas, talus slopes. Feeds primarily on insects: Rock wren.

3) Nests on high, exposed cliffs. Feeds in air on birds: Peregrine falcon.

Endangered and threatened species that use, or may possibly use, the EAR area include the State-listed northern spotted owl and northern bald eagle and the Federally-listed Peregrine falcon (American and Arctic races). Dr. Robert Storm of Oregon State University believes the spotted frog (State-listed threatened species) has been extirpated from all areas within the EAR area.

Several tracts of old-growth timber within the EAR area will be classified as "crucial" habitat (for northern spotted owls) as prescribed by Bureau Manual 6610.3. The wide range of habitat values provided by these tracts are shown on Map 8.

There are no known nests of bald eagles or osprey on BLM land in the EAR area. An osprey nest is known to exist on private land near Noti and another is suspected near Triangle Lake. There are approximately a dozen osprey nests on private land outside the EAR area at Fern Ridge Reservoir and along the Willamette River near Dexter.

With the exception of those species mentioned above and the Oregon slender salamander, which is confined to the Cascade Range, species included in the preceding list are believed to reproduce regularly throughout the EAR area where suitable habitat exists. There are two known great blue heron rookeries on BLM land: one near Dorena Reservoir and one near Noti.

H. Ecological Interrelationships

1. Environment

All living things - plants, animals and humans - that make up a biotic community are surrounded by conditions that affect them in their struggle for existence. All organisms share a common need for sustenance to continue their life processes and reproduction cycles. They must interact each with the other to fulfill their individual needs. Any environment changes continually and the life that inhabits it must become adapted if it is to survive.

2. Plant/Animal Communities

Plants and animals do not ordinarily live alone. Instead, they live together in communities. Within the study area are many such associations, each holding its own particular set of plants and animals.

The coniferous forest of the study area is dominated by Douglas-fir trees. They make up an ecosystem that is cool, moist and shady where only certain kinds of biota can thrive. In the ground live certain decay bacteria and fungi which change dead plant and animal matter into food for plants. In the trees and other plants are many kinds of insects that serve as food for insect-eating birds of the community. Many small mammals native to the area live on the forest floor where they gather and feed on fruits, seeds and small plants. These small animals in turn become food for the owls, hawks, coyotes, bobcats and other predators of the community.

The number of organisms involved in the amount of energy passing through the food chain becomes smaller with each successive link. The animals at the lower end of the food chain are most abundant. Successive links of carnivores decrease rapidly in number until there are very few carnivores at the top. This concept is known as the pyramid of numbers and when drawn out graphically appears in the form of a triangle.

Along the forest edge and expanding outward into newly-logged areas and older loggings is a series of ecological communities succeeding one another in stages of biotic development. At their edges, for instance where forest and cutover lands merge, each community blends in with one or more communities. These blending-in areas are called "ecotones." Streams of the study area blend with several communities as they trace their ultimate path to the ocean forming riparian habitat, a classic "ecotone." Life found in the streams interacts in much the same manner as described above, dependent upon factors which affect all, but are somewhat more vulnerable than their terrestrial counterparts for they cannot move from their aquatic environment and relocate elsewhere.

3. Food Chain

All food chains directly or indirectly relate back to living plants. Plant and animal communities occur together in the same habitat and have many interrelations, forming a biotic community. The biotic community along with its habitat is termed an ecosystem. Food chains follow a general plan; however, the first link, as stated, is always a plant or some part of a plant. Collectively, food chains are called "food webs." These are very complex in nature.

4. Competition and Cooperation

The plants of a community compete with each other for growing space, light, soil, minerals and other necessities. The animals compete for food and shelter and, among the same species, for mates. For both plants and animals, life is a continuous struggle against enemies and unfavorable conditions in the environment. Only the fittest survive. Yet, despite all the struggle and competition, there is a great deal of cooperation among living things. Plants help animals by providing them with food and shelter and places to raise their young. Animals help plants by spreading their seeds, by carrying pollen from one plant to another and by destroying harmful insects and other plant enemies. The forces of competition and cooperation tend to keep the varieties and populations of plants and animals of a community at roughly the same levels year after year as long as man does not interfere with the environment.

5. Community Structure

Biotic communities are organized in ways other than food chains. Most are arranged in horizontal layers called stratifications. The coniferous forest of the study area and adjacent lands, beginning at the soil, has four layers:

a. Subterranean - The soil layer contains the roots of trees, fungi and other plants. Worms, shrews, moles and other burrowing animals are common to this area.

b. Forest Floor - Composed of fallen leaves, twigs, debris and herbaceous plants which serve as a home or feeding place for a variety of insects, mammals and ground-dwelling species of birds.

c. Shrub Layer - Contains small trees, shrubs, large tree trunks and a vast and diversified host of insects, spiders, moths, tree frogs, birds and other animals.

d. Canopy - Here are the leafy crowns of the larger trees bearing the full brunt of the elements and shielding the layers below.

6. Community Rhythms

Plants and animals of the assessment area show day and night cycles of activity. Some animals, such as the bat species found in the study area, are rarely seen by the casual observer. They are usually active at night and rest during the day. Some animals, such as the deer and elk found, are most active during the early morning and late evening hours. In some communities, there are more animals active during the daylight hours. In some communities, the reverse is true. Seasonal rhythms are seen in the reproductive cycle of the fish and wildlife of the study area. Many species, such as elk, deer, bear and anadromous fish, have specific breeding or spawning periods.

7. Succession

The process of nature's changing of the various plant/animal communities is known as succession. Over a period of years, the environment changes, new kinds of plants and animals begin to replace the previous occupants, to be in turn, replaced by others. This is evidenced in the study area by the many stands of old-growth timber in staggered settings with cutover lands. In nature, as in man's way of timber harvest, the process goes on and on - one community giving way to another until a "climax" community is reached. The climax community is the one best adapted to the environment which shaped it and will remain indefinitely. In the study area, the coniferous forest of shade-tolerant species is a climax community.

I. Landscape Character

The majority of the assessment area is located within the Western Cascade physiographic province. Several isolated tracts of BLM lands are located within the Willamette Valley physiographic province. And the western edge of the assessment area carries over into the Coast Range physiographic province. For the purpose of descriptive analysis of the landscape characteristics, the study area is broken into the following units: (1) Upper Willamette Valley, (2) Lower McKenzie Valley, (3) Western Cascades Foothills, (4) Western Cascades, (5) Coast Range, (6) Smaller Tributary Valleys and (7) Cascade Reservoirs (see Map 9).

1. Upper Willamette Valley

The Upper Willamette Valley is a broad (15-20 miles wide), flat-bottomed valley bordered by rolling foothills of the Coast and Cascade Ranges. The valley splits into three narrower arms at the southern end. One arm is the Lower McKenzie Valley described below. Another arm follows the Coast Fork Willamette River to Cottage Grove.

The main valley floor is predominantly agricultural land meandered by the Willamette River and tributary streams. The Willamette River is obscured from the rest of the valley floor by dense brush and tree vegetation along the river bank. The main river is multi-channeled with a broad flood plain. Tributary drainages, large and small, are lined with brush and trees creating a latticework of vegetative breaks throughout the valley.

The edges of the valley are dotted with small, isolated buttes (eroded residual basalt flows and plugs) rising 200-1,000 feet above the valley floor. These buttes are generally forested providing islands of timber within the basic agricultural fields framework of the landscape. All of this provides a great variety of form, line, color and texture. The buttes are conspicuous in form. Contrast between the color and textures of cropped lands and pastures and wooded lands provides form and line. The numerous roads and fence lines also provide a network of lines. The color through most of the year is various shades of green. The main "visual axis" of the valley is Interstate Highway 5 which runs north and south closely paralleling the east side of the valley. The woodland fringes of the valley tend to blend into the Cascade Foothills so there is seldom a sharp delineation between the valley bottom and the bordering foothills.

2. Lower McKenzie Valley

The Lower McKenzie River Valley is much narrower than the Willamette Valley, averaging 1½-2 miles wide. The valley floor is dominated by the ordered lines and forms of a rural countryside. Dominant are the roads, fences, fields, farm buildings and houses of a rural agricultural setting. Small communities and rural homesites are scattered everywhere. Form in the valley tends to be small scale and fragmented. Form of the fields and openings on a larger scale is more evident from elevated viewing points along the edge of the valley, but fiew of those are accessible to the public. Color and texure vary as to land use and season of the year. There is a diverse mixture of orchards, pasture, plowed fields and woodlands.

The McKenzie River is not a dominant visible feature throughout the lower valley except as seen from the air. For the most part, it is obscured from the remaining valley floor by elevated, tree-lined riverbanks. The river and riverbank area retain a semi-primitive, natural appearance with tall hardwoods and conifers lining the meandering riverbank and screening the river from an otherwise man-intruded landscape. Where the river is visible, it is clearly the dominant feature of the landscape.

The adjacent foothills, described in the following section under Western Cascade Foothills, are a dominant part of the scene and lend some form to the overall scene. However, these foothills are generally rounded and relatively low in elevation (to 1,700 feet above the valley floor), hence not striking. In the foothills, the vegetative texture of the coniferous forest is about as dominant as the topographic form. Recent clear cut harvest openings in the forest canopy of the foothills are common and evident in the background but are relatively rare in the foreground.

3. Western Cascade Foothills

The Western Cascade Foothills are dominated by topographic form and vegetative texture. The general pattern of land form is low, rounded hills rising to moderately-sloping mountains. The foothills have a well-developed dendritic drainage pattern. Hill masses rise gradually and culminate in one or two peaks which stand above the others. The higher peaks rise 2,700-2,900 feet above the Willamette Valley floor. Overall, the net relief is more on the order of 2,000 feet. Several streams, tributary to the Willamette and McKenzie Rivers, have carved smaller, satellite, flat-bottom valleys which penetrate from 3-14 miles into the hill land masses (these valleys are described as a separate unit below).

The vegetative cover of the foothills is predominantly coniferous forest. However, substantial inroads by intruding hardwoods and substantial clear cut harvested areas leave a contrasting patchwork landscape with a character of its own. The size of individual clear cut harvested areas varies from less than 20 acres to over 1,000 acres, though the average-size, individual cutting units range from 30-160 acres. The interspersed public and private ownership pattern on a rectangular grid base tends to result in a timber harvest pattern that produces vegetative lines (cutting lines) and forms (shape of clear cuts) in a rectilinear pattern that disregards natural features.

4. Western Cascades

Like the foothills, the Western Cascade Range is dominated by topographic form and vegetative texture. The usual land form is moderately- to steeply-sloping mountains with a deeply-incised dendritic drainage pattern. The bulk of the range is fairly uniform in form with peaks generally terminating at the 3,000-3,500 foot level. There are many scattered, somewhat-prominant peaks which rise above 4,000 feet in elevation. Viewed from the distance, these peaks tend to stand out as weakly dominant features. Overall relief from valley bottoms to mountain tops is ordinarily 2,000-3,500 feet.

The natural vegetative cover is a dense stand of conifer timber. Some small openings are usually evident near the higher elevations of the mountain tops where shallow soil, rockslides and rock outcrops have precluded tree growth. Superimposed on this natural pattern is the clear cut timber harvest pattern which has stripped vast areas of dark-green, old-growth timber and substituted brown stump fields and patches of lighter-green, young conifer trees. The evidence of recent logging activity is extensive on intermingled BLM and privately-owned lands, leaving small islands of mature timber among a sea of cutover, though largely revegetated, lands. Timber cutting on National Forest lands resembles a patchwork quilt of cutover units superimposed on the mature timber base fabric. On privately-owned lands, entire stream drainages of several thousand acres in extent have been stripped nearly bare of old-growth timber, leaving brush and very young timber in its place.

Unnatural lines in the form of road cuts and logging skid marks are evident on recently logged-over hillsides, though these scars are generally concealed in a few years by new vegetation. The relatively uniform, dark-green color of the old-growth forest is rapidly being supplanted by the lighter green of younger conifers, brush and hardwoods as well as the browns of recent clear cuts. Topographic lines, except the skyline, tend to be muted by the green color and uniform textures of the vegetative cover. Natural topographic ridge and gully lines stand out boldly after the vegetative cover has been removed.

5. Coast Range

The natural landscape of the Coast Range is also dominated by topographic form and vegetative texture. The land form is mountainous with a deeply-dissected dendritic drainage pattern characteristic of a geomorphically "early mature" land form. The main streams - Siuslaw River, Wolf Creek and Lake Creek - have cut deeply into the land mass. These major streams flow through narrow, but generally leveled, valley bottoms where the streams themselves tend to meander within tightly constrained limits. Side drainages are in V-shaped valleys and have steeper gradients with extremely steep headwalls. The mountains tend to terminate in slightly-rounded, narrow ridges. There are few dominant peaks in the Coast Range. Most of the ridge tops rise to a height between 1,400-2,000 feet above sea level. The Siuslaw River Valley is at the 500-foot level. So, the net relief is on the order of 900-1,500 feet.

The naturally rugged form of the mountains is softened by the dominant green color of the vegetation and the texture of the conifer forest. The vegetative cover has been modified so extensively by timber harvest that the natural vegetative pattern of a dense canopy of old-growth conifers has been largely supplanted by the patchwork design of clear cut logged areas in various stages of revegetation, interspersed with relic stands of remaining old-growth conifers.

The shape and size of individual, clear cut harvested units varies from less than 20 acres to over 600 acres, though the average-sized individual unit tends to be around 30-100 acres. The interspersed public and private ownership pattern on a rectangular grid base tends to result in a timber harvest pattern that produces vegetative lines (cutting lines) and forms (shape of clear cuts) in a rectilinear pattern that disregards natural features.

The Coast Range generally features "enclosed landscapes" such as narrow valley bottoms bordered by steep hills and ridges, road corridors bordered by trees and hills, or stream channels enclosed by adjacent trees and brush. Views are limited from the most-used vantage points and travel routes. The visitor seldom sees beyond the foreground distance (three miles or less).

6. Smaller Tributary Valleys

These include the Calapooya River Valley, the Mohawk River Valley, Camp Creek Valley, Lost Creek Valley, Row River Valley, Mosby Creek Valley, Coast Fork Willamette River Valley (above Cottage Grove), Lynx Hollow Valley and Camas Swale Valley. These tributary valleys have fairly flat bottoms ranging in width from three-quarters of a mile to three miles at the widest points. They are basically agricultural in character with fenced pastures and farm woodlots prevailing. Croplands and orchards are also quite evident. The landscape portrays the typical agricultural pattern of fields, fence rows, roads, barns and rural homes.

The streams themselves are seldom seen unless the viewer is within a few hundred feet of the streambed. However, the tree-lined stream banks form long, sinuous lines of vegetation meandering among the fields and woodlots. Major inharmonious intrusions in the Mohawk and Camp Creek Valleys are the high-voltage electric power transmission lines with massive steel towers and strong, eye-catching, vegetal-clearing lines.

Within the valleys, line, texture and color are the dominant elements, while topographic form and vegetal texture are dominant on the surrounding foothills. Because the valleys are so narrow, the landscape of the valleys tends to be subordinate to the more massive landscape of the surrounding hill lands.

7. Cascade Reservoirs

There are five major flood control reservoirs on the Willamette River and tributaries within the vicinity of the assessment area. These are Dexter, Lookout Point, Fall Creek, Dorena and Cottage Grove Reservoirs. They are actually man-created intrusions that have enhanced the landscape - at least during the major portion of the recreational landscape viewing season. In each case, the reservoir body of water is enclosed by moderately- to steeply-sloping mountains. The view unit includes the water body as well as the surrounding mountains seen from the surface or perimeter of the reservoir. Steep, mountainous ridges bordering Fall Creek and Lookout Point Reservoirs emphasize enclosure of the scenes while Cottage Grove, Dorena and Dexter Reservoirs are only moderately enclosed by moderately-sloping hills and mountains.

All of the reservoirs are elongated in form corresponding to the flooded river valley bottoms enclosed by elongated, mountainous ridges on either side. Strong lines are formed by the water body shorelines where the water surface texture meets the largely forested hills. This line is very strongly emphasized when the water level of the reservoirs is dropped in the late summer, fall and winter months leaving a wide, brown ring of exposed soil and mud dotted with old tree stumps. Dexter, a regulating reservoir for Lookout Point, is the only reservoir maintaining a constant level. The others are often nearly drained of water in preparation of containment of spring runoff waters. During most of the summer recreation season, the reservoirs are filled and resemble a natural body of water; but the drawdown transforms a pleasing visual asset into an ugly, unharmonious liability.

The dams themselves are earth fill structures with broad, sloping, rock- or grass-textured faces. The symmetrical form of the dams appears somewhat unnatural but they do borrow massive form, slope lines and texture from the hills surrounding the reservoirs.

Scenic Values. The quality and sensitivity level of the visual environment of the assessment area have been inventoried according to principles contained in BLM Manual 6310, Visual Resources Inventory and Evaluation. Map 10 depicts the results of that inventory.

The "scenery quality" is a judgment based upon the composite visual effect of the following factors: land form, color, water, vegetation, relative uniqueness and intrusions. It is rated as: (1) A scenery - outstanding quality; (2) B scenery - above average in visual interest quality; (3) C scenery - common scenery with little special visual interest.

The visual resource use sensitivity level is a conclusion derived from an assessment of factors including: visitor use volume, visitor use activity association, community attitudes, nonBLM uses of land and other public agency interests. Sensitivity levels are rated high, medium or low.

Another factor influencing visual use sensitivity is the proximity of the visual scene to the viewer. "Visual zones" as seen from high and medium sensitivity areas, viewpoints and travel routes are delineated on the map. Visual zone designations are: (1) Foreground-Middleground - the area that can be seen from each travel route or sensitive area for a distance of 3-5 miles, or the point where the texture and form of individual plants is no longer apparent; (2) Background - the remaining area which can be seen from sensitive areas and travel routes; and (3) Seldom Seen - the area generally hidden from view from the high and medium sensitivity areas.

J. Wilderness

As defined in Section 2(c) of the Wilderness Act (Public Law 88-577): "A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value."

There are no BLM-administered lands within the assessment area which meet this definition. There are likewise no existing national wilderness areas on surrounding lands which might be impacted by the proposed action.

K. Educational and Scientific Values

1. Historic Values

Initial settlement of the immediate Eugene and Pleasant Hill areas occurred in 1846-47; however, extensive settlement of the upper Willamette Valley did not take place until the decade of the 1850's. Attracted by liberal land claim policies and a developing market for farm products, settlement of the main valley and larger tributary valleys proceeded at a rapid pace. 1/

Logging and, to a lesser extent, sawmilling, began during the decades of the 1850's-60's to meet local demands for building materials. Extensive development of the lumber industry did not occur until the closing decades of the 19th Century and the initial decades of the 20th Century. Attendant to this development were numerous small mills and the infrastructure necessary to supply them with logs. The economy of the 1930's dealt a severe blow to the forest products industry resulting in the closure of many of these facilities. The advent of the integrated mill and the widespread use of logging trucks following the economic recovery eliminated the necessity for these "upriver" facilities and they have long since been torn down or incorporated into the modern transport infrastructure. 2/

Transportation of goods and passengers evolved rapidly within the Willamette Valley. The Willamette River served as an avenue of trade from the Eugene area to the lower valley until the arrival of the railroad in 1870. A stagecoach route linking Portland with San Francisco and points east was developed in the later 1850's and continued to operate until supplanted by the railroad in the 1870's. This coach road followed the valley of the Coast Fork of the Willamette thence over the Calapooya Divide and into the Umpqua Drainage. 3/ A portion of this route lies within the assessment area but does not cross public land. All traces of this road have long since been destroyed by or incorporated into the modern transport infrastructure. This also holds true for lesser roads which served the various smaller valleys.

1/ Harlow Head, The Oregon Donation Land Claims and Their Patterns (Unpublished Ph.D. Dissertation, University of Oregon, 1971).

2/ Archie W. Mbogho, Sawmilling in Lane County, Oregon: A Geographical Examination of its Development (Unpublished Masters Thesis, University of Oregon, 1965).

3/ D. G. Holtgrieve, Historical Geography of Transportation Routes and Four Populations in Oregon's Willamette Valley (Unpublished Ph.D. Dissertation, University of Oregon, 1973).

A wagon road used to transport supplies to the Bohemia mining area (east of the assessment area boundary) followed Sharps Creek valley. Construction of this road was begun in the 1870's but the road was not completed until near the turn of the century. All traces of this road have been destroyed or incorporated into the modern road system in the assessment area.

Ten sites listed on the Statewide Inventory of Historic Sites and Buildings are located within the assessment area. The ten sites include two schools, two residences (one constructed in the 1860's), one store-post office and five covered bridges. None of the listed sites are on public land. There are no National Register sites within the assessment area.

2. Archaeological Values

The Willamette Valley from Oregon City to its southern terminus was inhabited during the early historic period by Kalapuyan-speaking peoples. Popular literature has referred to these peoples as the Kalapuya (various spellings) tribe, ascribing a level of sociopolitical integration to them which may not have reflected reality. The Kalapuya were divided into nine or ten dialect groups, each associated with a district territory. These geographically distinct dialect groups do not appear to have been each under the authority of a chief prior to 1851 when the territorial government directed the groups to appoint chiefs. Prior to this point in time, each dialect group was organized into a series of bands; each band under a headman who attained the position through demonstrated ability. 4/

Ethnographic and archaeological evidence indicate that the Kalapuya practiced a hunting and gathering subsistence economy utilizing a wide range of vegetal and animal foods. 5/ Activity loci associated with the subsistence economy range from camas processing sites on the main valley floor to hunting camps in the foothills. 6/ Evidence from scientific excavation and site reconnaissance indicates that this pattern existed by approximately 4000 B.C. There is a paucity of evidence relating to the period prior to 4000 B.C., but casual finds of projectile points would indicate that the valley was inhabited as early as 8000 B.C.

4/ Jan Peterson, "A Sketch of Kalapuya Ethnography," Archaeological Studies in the Willamette Valley, Oregon (University of Oregon, Anthropological Papers, No. 8 (ed.) C. Melvin Aikens, 1975).

5/ Ibid.

6/ John R. White, "A Proposed Typology of Willamette Valley Sites," Archaeological Studies in the Willamette Valley, Oregon (University of Oregon, Anthropological Papers, No. 8 (ed.) C. Melvin Aikens, 1975).

The public lands included in the assessment area are largely confined to the foothills and the archeological sites present represent a limited range of activities. Sites located on privately-owned property in the valleys are associated with a different set of activities and, in conjunction with the upland sites, present evidence for the broad range of extractive activities.

A search of the Oregon Archaeolgical Survey files and a review of the relevant literature revealed 25 recorded prehistoric sites within the boundaries of the assessment area. Fifteen of the recorded sites are located on public lands, nine are located on private property and one is located on property managed by the Corps of Engineers. None of the sites in question have been selected for nomination to the National Register of Historic Places.

Areas of known archaeological value within the assessment area (Map 11) encompass the locations of recorded archaeological sites. The potential for discovery of additional sites within this zone is great.

Areas of potential archaeological value within the assessment area (Map 11) encompass locations of reported or predicted, but as yet unsubstantiated, archaeological values. Site occurrence prediction is based on two factors: (1) proximity to areas of known archaeological value and (2) recorded sites located in similar settings either within or outside the assessment area.

The upper reaches of the Mosby Creek and Big River valleys are not incorporated in either of the evaluational categories. In both instances the narrow valley floors in question were subject to surficial erosion and lateral stream course changes in the recent past and have been significantly disturbed by modern road construction. These factors militate strongly against the discovery of prehistoric sites in either location.

3. Paleontological Values

Paleontological resources within the assessment area are limited to a single locality situated at the south end of Dorena Dam (Map 11). 7/ Baldwin has indicated that the tuffaceous sandstones exposed at this locality contain marine invertabrate fossils similar to those present in the Oligocene Age, Eugene Formation. 8/

7/ Dallas L. Peck, et al., Geology of the Central and Northern Parts of the Western Cascade Range in Oregon (Geological Survey Professional Paper 449, 1964).

8/ Ewart M. Baldwin, Geology of Oregon (rev. ed., 1976).

4. Paleobotanical Values

Paleobotanical specimens have been recovered from the Oligocene-Miocene Age, Little Butte Volcanic Series which outcrops over much of the area. Four United States Geological Survey paleobotonical localities (9031, 9419, 9434, 9435) and one unrecorded locality are present in the southern portion of the assessment area (Map 11). [9]

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[9] Dallas L. Peck, et al. (1964).

L. Other Land Uses and Local Regulatory Structure

For purposes of discussing present land uses, the assessment area has been divided into two subareas. Map 12 shows these two subareas as well as the major land uses within each. Subarea 1, containing about 40,000 acres, includes that portion of the assessment area strongly influenced by its proximity to the Eugene-Springfield metropolitan area. Subarea 2 comprises the bulk of the assessment area and contains approximately 220,000 acres.

1. Subarea 1

Historically, the lands within the subarea were primarily used for timber production, agriculture and grazing. More recently, reflecting the urbanization of Creswell and Cottage Grove and the rapid growth of the Eugene-Springfield area, there has been substantial pressure for residential development. Over the last ten years, population has increased about 33 percent and projections place future growth between two and three percent through 1995. 1/ Even the rural fringes of the subarea are experiencing residential pressures. Homesites of 1-10 acres are being developed in neighborhood clusters and small, part-time "ranchettes" are replacing the traditional timber and agricultural operations.

2. Subarea 2

The land ownership patterns within the subarea are generally in large parcels. Approximately 81,000 acres (37 percent) is public land managed by the Bureau of Land Management. The private lands, intermingled with the public lands in a checkerboard pattern, are predominantly owned by lumber companies. Except for a few small agricultural areas along the Coast Fork Willamette and Row Rivers and Mosby Creek, the vast majority of both public and private ownerships are managed as commercial forest land. These commercial lands have a highly-developed road system. An average of 2-3 miles of rocked forest roads and many lower-standard spur roads in each section (640 acres) have been built to harvest and manage the timber resource. The subarea is sparsely settled with homesites in the flatter stream valleys along major roads. With the exceptions of the London area and the Dorena-Culp Creek area, there are few development concentrations. Population trends over the past 20 years show a mixed history of ups and downs; the ending population corresponding almost exactly to that of the beginning. At most, population growth through 1995 is projected to be slow, with an annual rate of less than 0.5 percent. 2/

1/ A Preliminary Comprehensive Land Use Plan for the Lower Coast Fork Subarea, Technical Report (Lane County, Oregon, July 1974), pp. 3-10.

2/ A Preliminary Comprehensive Land Use Plan for the Row River-London Subarea, Technical Report (Lane County, Oregon, 1975), pp. 4-7.

3. Local Zoning

Historically, the vast majority of rural lands have not been subject to any zoning restrictions and little control was afforded over development generally. More recently, there is a growing recognition of the need for land use regulation even in the more remote rural areas. For the past several years, Lane County, which contains about 86 percent of the assessment area, has been deeply committed to comprehensive land use planning. The County has been divided into 12 planning units or subareas. The divisions are based primarily on natural features and existing land use patterns.

Though the subarea planning process is ongoing, some areas are complete and adopted. The Lower McKenzie, the Lower Middle Fork Willamette and the Lower Coast Fork Willamette are the three plans within the assessment area that have been adopted and in which the zoning process has begun. Map 13 shows the "Plan Diagram" for these subareas as well as the boundaries of the other subareas within the scope of this assessment. For a complete interpretation of the plan diagrams, it is necessary to refer to the findings, goals, objectives, recommendations and descriptive analysis contained in each respective subarea plan.

Zoning has been completed in both the Lower Middle Fork Willamette and the Lower Coast Fork Willamette subareas and all but 160 acres of public lands have been included in a Forest Management District (FM). The FM zone is intended to preserve and protect lands for continued timber production, harvesting and related uses and to protect watersheds, wildlife habitats and other such uses associated with the forest. It generally permits the management, growing and harvesting of forest crops; general farming; grazing; fish and game management; rock quarries; mineral exploration; and, on a minimum lot size of 40 acres, single-family or two-family dwellings. 3/

There are three widely-scattered parcels of pulic lands, totaling about 160 acres, not in an FM zone. These parcels have been designated as within a Farm Forestry District (FF20). The FF20 zone provides for farming, grazing or timber production areas as free as possible from urban conflicts and other incompatible uses. It generally permits the management, growing and harvesting of forest products; general farming; grazing; certain facilities to complement the aforementioned activities; and, on a minimum lot size of 20 acres, single-family dwellings. As conditionsl uses, the zone allows the permitted uses on lots less than 20 acres as well as sand, gravel and mineral extraction. 4/

3/ Summarized from Lane County Zoning Ordinances. For specifics, refer to Lane Code, Chapter 10, Zoning.

4/ Ibid.

Included within and/or immediately adjacent to the assessment area are two communities recognized by Lane County as "Major Development Centers." These communities, Cottage Grove and Creswell, are designated as suitable areas where growth should be encouraged and accommodated. Map 13 depicts these areas and their respective "Community Planned Boundary." 5/

5/ A Comprehensive Land Use Plan for the Lower Coast Fork Subarea (Lane County, Oregon, June 1975) pp.44-45.

M. Economic and Social Characteristics

Lane County ranks second in population among the 36 counties in Oregon with approximately ten percent of the State total. The 1974 populatio was estimated at 237,000 which is an increase of 45 percent over the 1960 count. This compares to a statewide increase of 28 percent during the same period. Approximately half of the County's growth has been attributed to in-migration. About 70 percent of the County's people reside in urban areas, primarily the Eugene-Springfield metropolitan area where most of the growth has been concentrated. 1/

The lands within the assessment area boundary are rural in character and sparsely populated. Those portions near Cottage Grove, Dexter and Creswell have experienced moderate growth but at a markedly slower rate than the urbanized areas of Cottage Grove and Creswell which increased 32 percent in population between 1960 and 1970. The rural portions of the assessment area near the growth centers named above are projected to grow at an annual rate of about two percent. 2/ 3/ The majority of the assessment area lying within the Row River-London subarea (see Map 13) had the same population in 1970 as it did in 1950 and is expected to grow little if at all during the next 20 years. 4/

The economy of Lane County "is built upon the export of goods and services. The industries which make up the economic base are lumber and wood products, food products, transportation, wholesale trade and higher education." 5/ The lumber and wood products industry is the most important in the County, accounting for 80 percent of the County's exports. In 1971, the lumber and wood products firms employed 17 percent of the area's total work

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1/ Oregon Economic Statistics, 1975, Bureau of Business Research (University of Oregon, Eugene, Oregon).

2/ A Comprehensive Land Use Plan for the Lower Coast Fork Subarea, Part II, Technical Report (Lane County Division of Planning, July 1974).

3/ A Comprehensive Land Use Plan for the Lower Middle Fork Subarea (Lane County Division of Planning, November 1974).

4/ A Comprehensive Land Use Plan for the Row River-London Subarea, Volume II, Technical Report (Lane County Division of Planning, 1975).

5/ Resource Atlas: Natural, Human, Economic, Public, 1973-74 (Lane County, Federal Cooperative Extension Service, Oregon State University, Corvallis, Oregon, August 1973).

force and 74 percent of those employed in manufacturing industries. The long-range outlook for lumber and wood products is for relatively stable or slightly declining employment levels reflecting continuing mechanization and the depletion of private timber reserves. 6/

Job opportunities within the assessment area are concentrated in lumber, wood products and agriculture to a much larger extent than in the County as a whole. These industries are often subject to seasonal employment fluctuations and the timber industry is particularly subject to national economic influences. The total number of jobs available within the assessment area is limited and a substantial percentage of workers commute elsewhere to work, many to Cottage Grove and the Eugene-Springfield metropolitan area.

The unemployment rate in rural portions of Lane County generally runs about a percentage point higher than the County as a whole. The County unemployment rate was ten percent during March 1977, which is higher than both the State and national averages.

Per capita personal income in Lane County has averaged $400-$500 below the State average in recent years. 7/ The State figure, in turn, has lagged approximately five percent below the national average.

Income generated from timber sales from BLM-administered lands in Lane County accounts for almost three percent of the total County income. The corresponding figures for Linn and Douglas Counties are 4½ percent and 15 percent, respectively. 8/ These percentages represent a significant role for BLM lands in the County economies, especially in light of a predicted future trend of increased reliance on public timber and a decline in timber harvest from the private sector. Income attributable to wildlife and recreation activites on public lands represented about 0.2 percent of total Lane County income and 0.5 percent in Linn County and is therefore considered relatively insignificant. The corresponding figure for Douglas County is somewhat higher at 1.2 percent. 9/

6/ Lane County Solid Waste Management Plan (Preliminary), (Lane County Department of Public Works, 1972), pp. 24-26.

7/ Oregon Economic Statistics, 1975, Bureau of Business Research (University of Oregon, Eugene, Oregon).

8/ S. Bennet, An Economic Profile of Western Oregon Counties, BLM Report (Western Interstate Commission for Higher Education, Boulder, Colorado, 1975).

9/ Ibid.

All three county governments are highly dependent upon direct revenue from BLM timber management activities. Proceeds from BLM timber sales are distributed according to the O&C formula (see Section I.B.2.g.2)). O&C receipts for fiscal year 1973-74 and the percentage of total county revenue they constitute are as follows: Lane County - $7,206,028 (23 percent); Linn County - $1,245,836 (13.6 percent); and Douglas County - $11,821.283 (50.5 percent). 10/ Receipts from Federal mineral leasing amounted to only $23 in Douglas County and nothing in Linn and Lane Counties during the same period. By comparison, the proportion of county government revenue derived from property taxes during the same fiscal year amounted to 9.4 percent in Lane County, 14.8 percent in Linn County and 6.0 percent in Douglas County.

The "Goals and Policies" document of the Lane County general plan, adopted in December 1976, lists the following economic and social problems for the rural areas and outlying communities (thus including the assessment area):

1. Rural Areas

a. Reduction of forest land potential. As development occurs in forest fringe areas, forest land is directly taken out of timber production and indirectly removed from production as conflicts arise between forestry practices and other land uses.

b. Disappearance of agricultural land. As development spreads into agricultural areas, conflicts between agricultural and other land uses arise to the detriment of agricultural operations, and property tax assessments rise creating economic pressures for nonagricultural land uses. The reult is that agriculture land is forced into premature sale and conversion into nonagriculture uses or nonuse.

2. Communities

a. Lack of diversified economic base. Most communities have limited local job opportunities, partially due to their dependence on one industry.

b. Limited local availability of social services. Vocational education, health and recreation opportunities are not adequate within some communities, thus creating transportation and convenience problems for residents desiring these services.

10/ Revenue Sources of Oregon Counties, Fiscal Year 1973-74, Bulletin 170 (Bureau of Governmental Research and Service, University of Oregon, Eugene, Oregon).

c. A high proportion of substandard housing units and a limited amount of adequate housing units available to low- and moderate-income families.

d. Low retention of youth and young families. Limited job, housing and social service opportunities contribute to the migration of young people from the communities for greater opportunity in metropolitan areas.

In the same document, the following goals and policies were enumerated:

3. Goal

Encourage a more diversified and improved economy for Lane County consistent with the maintenance and protection of the environmental resources.

4. Policies

a. Encourage the creation of an independent diversified local economic base for those communities recommended as growth centers.

b. Encourage communities recommended as growth centers to have adequate public physical facilities and social and educational services to make them attractive for private development.

c. Emphasis should be placed on investment of both private and public funds for public works projects and social and educational facilities and services to those communities recommended as growth centers and to transportation and communication linkages between them.

d. Encourage new industrial development in communities designated as major growth centers which have the potential for a broad economic base and the ability to support additional economic activity.

e. Encourage the development of environmentally compatible tourist and recreational facilities which can enhance the economic prospects of rural areas while serving the recreational needs of tourists and county residents.

f. Maintain and improve the long-range stability of the forest products industry and related land base.

g. Maintain and encourage agriculture as an important segment of the economy.

Additional data pertaining to the social and economic characteristics of Lane County and the assessment area are available in the references cited.

III. ASSESSMENT OF PROPOSED ACTION

A. Introduction

The following section describes potential environmental impacts of oil and gas field operations on the components which were identified in the previous chapter and recommends specific measures to lessen or preclude such impacts. The five phases of oil and gas field operations, as described in Part I, comprise a step-by-step procedure with each succeeding step dependent upon successful indications in the previous step. Only a small percentage of lands leased are ever drilled and only a few oil and gas explorations go beyond the drilling of an initial exploratory well. Nevertheless, each succeeding phase through production is a more intensive operation with the degree of impact greater than in the previous phase.

To make this assessment, the following constraints and conditions were assumed:

All lessee's operations will be in conformance with applicable Federal and State laws and regulations and standard lease stipulations as detailed in Section I and as summarized in Section I.B.6. The proposed action as it is controlled by such laws, regulations and stated operating procedures is what is being analyzed.

Additional site-specific environmental assessments are a prerequisite to all surface-disturbing explorations and/or development operations. The purpose of such subsequent analyses is to identify the environmental impacts of the proposed operations and to recommend appropriate mitigating measures to be included in the operations permit.

Road construction associated solely with oil and gas exploration will not be extensive. The existing forest road system is highly developed and designed for logging loads similar to those loads associated with exploration equipment. Additional road construction would be quite costly and possible locations are physically limited by topography.

A moderate oil and/or gas discovery is the maximum reasonable level of development. Any production will be transported to existing refineries for processing and distribution. This is based upon the history of oil and gas exploration in Western Oregon. More than 100 wells, ranging in depth from less than 2,000 feet to over 10,000 feet, have been drilled with no commercial discovery. While such history is not conclusive, it appears reasonable to assume that any future commercial discoveries will be small to moderate in size, not justifying the installation of refineries.

In addition to these assumptions, the following assessment must also consider the possible types of impacts associated with the unpredictable - accidents and errors in judgment, e.g., oil spills, fires and well blowouts.

Since they are unpredictable happenings, the size or degree of the impact is debatable. A view of recent exploration and development history may help bring some insight to such a debate.

In fiscal year 1975 (July 1, 1974 - June 30, 1975), according to the USGS, fires and well blowouts occured on 20 of the 10,092 onshore producing, Federal leases as follows:

Fires

Wyoming - 7
Oklahoma - 2
Mississippi - 1
10

Blowouts

Wyoming - 2
New Mexico - 4
Colorado - 2
Utah - 1
California - 1
10

At this same time, a total of approximately 102,800 Federal oil and gas leases were in affect on public lands in the United States.

Table 6 is a compilation of crude oil spills reported to the Environmental Protection Agency in five western states during 1972. The figures represent only oil spills attributed to field operations and do not include the transportation or the refining of crude oil. Of the total spills, 40 percent resulted from flowline corrosion or freezing. The remaining spills were caused by human error, mechanical failure, natural causes, poor maintenance or, in a few cases, vandalism. The statistics relate to spills on all ownerships - private and State lands as well as Federal.

TABLE 6

Crude Oil Spills During Oil and Gas Development and Production Activities in Five Western States in 1972

State	Total Reported	Total* Barrels Spilled	Average Number of Barrels per Spill	Wells in** Production	Number of Spills per 100 Wells in Production
Colorado	37	896	24	2,700	1.4
Montana	27	1,960	73	4,210	0.6
North Dakota	19	813	42	1,490	1.3
Wyoming	74	9,676	131	9,300	0.8
Utah	16	1,434	90	900	1.8

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* 646 bbls. will cover one acre to a depth of one inch (646 bbl. = 1 acre-inch).

** 1971 figures.

Source: Environmental Protection Agency, Region 8, Denver, Colorado.

B. Perspective

Adverse impacts can be viewed in perspective by categorizing them as follows:

1. Impacts Which Frequently Occur in Conjuction With Other Public Land Uses

Mass soil and rock movement
Erosion
Sedimentation
Dust
Smoke
Noise
Fire
Timber production losses
Impacts on wildlife
Visual impacts
Impacts on recreation
Impacts on research and special interest areas
Transportation system impacts
Impacts on cultural resources

2. Potential Impacts Peculiar to Oil and Gas Development

Seismicity
Subsidence
Chemical contamination of water and soil
Unpleasant odors

Federal land management agencies have considerable experience in dealing with impacts listed under Category 1. They are problems regularly encountered in conjunction with other land management activities. Most of the potential impacts listed under Category 2 may prove to be no problem in the assessment area or they may be minimized or mitigated by application of existing technology.

C. Anticipated Impacts

1. Road and Drilling Site Construction

Road and site construction is an important operation that could have significant impact on the environment. Such construction is a possibility in preliminary investigations, exploratory drilling and development. Since the impacts of road and site construction are similar and these items could possibly occur in several of the stages of implementation, they will be analyzed as separate entities to eliminate repetition.

Dust from construction activities, especially during the drier months, and exhaust fumes from equipment would have a temporary localized adverse effect on air quality. Smoke from slash fires associated with clearing operations could also cause a temporary degradation of air quality although the area burned and volume of slash would be relatively small.

Soil erosion and slope failures may increase with the construction of access roads, trails, drill pads, tank batteries, pipelines and other field facilities. The increase would result from the removal of protective vegetation, forest floor litter and humus layers, soil compaction, alteration of natural drainage systems and undercutting and overloading of natural slopes. Surface-disturbing activities are especially critical within the assessment area on approximately 36,300 acres which have a high erosion hazard and on about 94,800 additional acres which also have a high landslide probability. These critical areas are approximately located as shown on Map 6.

Such erosion and slope failures would increase stream sediment loads, thereby adversely impacting species listed in Life Forms a.2), a.4)a) and 1.d. (see Section II.G.1.). Sediment in suspension can directly kill fish by damaging their gills if concentrations are high and exposure prolonged. Sediment also blocks the transmission of light, reducing algae and vascular plant production and impairing the ability of fish to feed. When sediment covers gravel spawning beds, it reduces survival of salmonid eggs and creates a physical barrier that prevents hatched fry from emerging through interspaces between gravels. Sediment can adversely affect other aquatic wildlife by filling living spaces, covering food supplies, interrupting reproductive functions and smothering aquatic invertebrates which may be used by fish and wildlife as food. Siltation of waterways also discourages recreation and inhibits angling for species that are sight feeders. This is particularly critical during spring when most fishing is done. The risk of increased sedimentation is greatest when construction activities are in close proximity to streams. Of major significance are stream channel relocations, stream crossings such as bridges and culverts and construction through stream headwall areas.

Stream channel changes, whether planned or accidental, frequently reduce total aquatic habitat and increase gradients. Increased gradients cause increased velocities, greater scouring and poor habitat. Fish cannot negotiate streams with excessive velocities. It has been demonstrated that streams with undisturbed natural channels will produce several times more fish than streams with altered channels.

Landslides and mudflows, in addition to increasing stream sediment loads with the effects discussed in the preceding paragraphs, may scour stream channels, removing spawning gravel, and block fish passage with accumulated debris.

Native vegetation, usually consisting of mature and immature timber species, will be destroyed and the growing site severely altered by the construction of roads, drill pads, tank batteries, pipelines and other facilities. These impacts would be most severe and could be long term on those sites difficult to revegetate, e.g., rock, shallow soils and steep, southern exposures.

The removal of streamside vegetation would influence the microclimate of riparian or aquatic habitats. Such removal would expose the water's surface to direct sunlight and could result in increased water temperatures. If enough exposure results, water temperatures may reach levels destructive to aquatic life.

Clearing of timbered areas could destroy nest trees used by northern spotted owls or other raptors. Snags, heavily used by species in Life Forms a.2), a.3) and a.4) (see Section II.G.1) could also be destroyed. Great blue heron rookeries and eagle nest sites could be abandoned by the birds if these activities occurred too close to them.

Such clearing could also have a favorable impact upon species of wildlife that utilize forest openings (Life Forms, Section II.G.1.c.) especially after the abandonment phase.

Noise and activity associated with construction operations would disturb terrestrial wildlife species within the more immediate vicinity of such operations.

Roads constructed during exploration or later phases of oil and gas development could open secluded areas used by wildlife to the presence of people. Associated shooting and vehicle use can result in wildlife harassment. Elk are particularly affected by such disturbance and the result could be the injury or loss of newborn calves and/or the forcing of animals into areas where they are more vulnerable to hunters or winter weather. Bald and golden eagles are also sensitive to such activities as they may cause nesting failures.

A number of road and site construction operations may produce visual impacts. New roads or trails constructed to facilitate geophysical exploration and pipeline or electrical powerline rights-of-way may produce linear features discordant to the natural landscape. Any clearings less than ten feet wide, however, will not generally be noticeable from a distance. Right-of-way clearings greater than ten feet in width tend to create gaps in the forest canopy that produce eyecatching lines.

Roads constructed for access to drilling sites or other field facilities would probably create 40-100 foot wide lineal clearings. Such roads would be similar to numerous logging roads in the area. The degree of visual impact will vary according to the specific location.

Clearings made for seismic exploration work or for drilling and production equipment could be visible to the public depending upon specific circumstances surrounding each site.

a. Drilling sites on steep hillsides and on ridges within the high- and medium-sensitivity level viewing zones would probably be visible to a large number of forest viewers. Sites adjacent to existing roads would also be visible to persons traveling along those roads.

b. Drilling sites on rolling hillsides or valley bottoms with a forest screen around them would probably not be visible to the viewing public except for the derrick which might temporarily extend above the tree line.

When the cleared drilling site is visible, a rectilinear clearing would be more discordant and offensive to aesthetic senses than would be an irregular-shaped clearing.

Cultural resources could be destroyed or obscured during any surface-disturbing construction activity. The educational and scientific value of a cultural resource, whether historic, archaeologic or paleontologic, is greatest when that resource is undisturbed. Additionally, the value of a cultural resource may be adversely impacted by adjacent offsite activities which destroy or substantially alter the original setting.

Discovery of previously unrecorded archaeological sites is a very real possibility. Construction of roads, drill pads and other facilities will necessitate the removal of vegetative cover from areas previously hidden from view. The uncovered areas will facilitate the search for archaeological resources. New or improved roads would provide better access to the sites.

New road construction associated with exploration and development could provide future timber management and recreation access.

As stated previously, the existing forest road system within the assessment area is extensive and it is anticipated that new road construction for oil and gas operations would be minimal, particularly during the preliminary investigation and exploratory drilling phases. If a commercial reserve is discovered and development occurs, the majority of new roads constructed would probably be short spur roads leading from existing logging roads. Each mile of road constructed to the standards required of BLM logging roads would utilize approximately 4.4 acres of land. Any well sites constructed would require about one acre of land.

2. Preliminary Investigations

Most of the activities conducted in a preliminary investigation, including geological, geochemical and certain geophysical surveys, cause little or no surface disturbance. The primary adverse impacts would be dust and noise from vehicle travel on existing roads.

The most intensive use that might occur during a preliminary investigation is a seismic survey. If the explosive method were used, major impacts could occur, including those discussed in the previous section which could result from the clearing and construction of new access trails or roads. Some dust and noise would also be produced by blasting.

If the vibrator method were used, all operations could be conducted on existing roads, thus requiring no surface disturbance. Due to lower operating costs and environmental considerations, this method will probably be preferred within the assessment area. Mobil Oil Corporation conducted vibratory seismic surveys on previously-leased Federal and private lands within the Eugene District during the spring and summer of 1977.

The primary adverse impacts anticipated from vibrator (or vibroseis) surveys are temporary blockages of narrow roads (possibly for several hours at a time), noise and dust from vehicle travel on roads and possible minor compaction damage to road surfaces.

A possible beneficial impact from preliminary investigation activities is increased knowledge of geological structures and conditions at depth beneath the assessment area.

3. Exploratory Drilling

The possible construction of a new access road, building of a well site or adapting an existing logging landing for a well site could result in impacts discussed under Section III.C.1., above.

Depending upon the location of the site selected for an exploratory well, a number of conflicts with other land uses and resource values could occur. Included are the following:

a. Oil and gas facility construction within the boundaries of an identified potential recreation site could be detrimental to the site's future recreation development, especially if many existing trees were cut. The potential recreation sites are shown on Map 12.

b. The conduct of oil and gas operations on or within 500 feet to one-half mile from a developed recreation site could be moderately disruptive of the recreational experience at the site because of noise and the visibility of equipment. This impact would affect a larger number of visitors during the summer season. The impact on the use of the site would be greatest if blowouts, spills or fires occurred or if production equipment were conspicuous and obvious from the principal access road to the site. The locations of existing recreation sites are shown on Map 12.

c. Well drilling in rock quarries could interfere with future use of the sites for rock production since both producing wells and abandoned, plugged holes would need to be protected from blasting and other destructive activities associated with quarrying operations.

d. Water quality could be adversely affected by the location of drill pads, tank batteries, pipelines and other field facilities within the flood plain of streams. Oil and other contaminants from blowouts and spills or from dikes and pipelines ruptured by high water could be released directly into surface waters.

e. Surface use of forest nutritional research plots, progeny plantations or proposed research natural areas (see Map 12) would substantially detract from or destroy the values for which they were established or proposed.

f. Surface use of a known or discovered cultural resource site could destroy its historic, archeologic or paleontologic value.

Exploration equipment, including drilling derricks, may or may not be visible to the public depending upon proximity to traveled roads and whether a timber screen was present or not. Bright-colored and reflective paint would accentuate the visibility of equipment. Drilling equipment is probably no more unsightly than logging yarders which are present in the area throughout the year.

Surface disposal of drilling mud visible from high- and medium-sensitivity roads or developed recreation sites would tend to create a visible unnatural intrusion on the land surface.

Noise and vibrations from road use and equipment operations are not expected to significantly impact the public except near recreation sites and residences within the assessment area. The noise could cause the temporary displacement of wildlife from the vicinity of the drilling site.

Although the chances are statistically slim, an accident (e.g., blowout, fire, oil spill or dike breach) could occur, potentially resulting in increased erosion through destruction of vegetation, contamination of surface waters, soil sterilization, temporary degradation of air quality by the discharge of odorous and toxic natural gasses, the destruction of wildlife habitat and the killing of both terrestrial and aquatic animal species. Species listed under Life Forms a.2), a.4)a) and 1.d. (see Section II.G.1.) would be impacted to the greatest extent. The aquatic habitat is particularly sensitive to the toxic, water-soluble fraction of crude oil which can continue to be released for some time from contaminated stream bottoms. Oil fires which may burn for prolonged periods would emit smoke and the products of hydrocarbon combustion into the atmosphere. Any fires which might result from oil and gas operations could create visible scars upon the landscape depending upon location and size.

An oil spill could also cause an adverse impact upon cultural resources during exploratory drilling or later development and production stages. The spill could contaminate charcoal samples, rendering them useless for radiocarbon dating.

Geologic hazards triggered by natural forces could damage oil and gas field facilities and cause oil spills, mud pit breaches, failures of road fills and other environmental problems during all phases of operations. Landslides could impact field operations if roads, well sites or other facilities were located on or below unstable slopes.

Some ground water aquifers may be penetrated by the exploratory drilling. If the wells are not properly cased, according to both Federal and State regulations, brines could contaminate ground water supplies.

The potential socio-economic impacts of exploratory drilling are discussed below in Section III.C.7.

4. Development

The impacts of drilling and associated operations of development are basically the same as those described in the exploration phase in the preceding section. Development of an oil field would require additional wells. The impacts of developing the roads and drill sites remain the same as in exploratory drilling; however, as the number of sites and roads and the amount of activity increases, the magnitude of the impacts could also increase. More storage tanks and/or flowliness would be needed for development, thus increasing the impacts of possible erosion and landslides. The increased number of storage tanks and flowlines could increase the chance of oil spills.

Gas field development requires less total area than an oil field. In the event of a gas field discovery and subsequent development, it is possible to have gas wells spaced every 160 acres as compared to the 40-120 acre spacing of an oil field. Gas fields do not require storage tanks, therefore the impacts of erosion and landslides should be of lesser magnitude than those of an oil field simply because less space is needed.

Land could be temporarily and/or permanently removed from timber production. The amount would vary directly with the size of oil and gas operations and could become significant if a large field is discovered and developed.

The potential social and economic impacts of increased construction and drilling activity are discussed below in Section III.C.7.

5. Production

During the latter stages of development or early phases of production, the system for transporting the oil and/or natural gas from the field would be established. In a producing oil field, the oil could be stored on the site in tank batteries and transported by truck or, depending upon production volume and topography, a pipeline might be constructed. Transportation from a gas field would likely be by pipeline to the Willamette Valley where it could tie into the existing gas pipeline network. The existing situation in Western Oregon with respect to pipelines, refineries and the procedures which would have to be followed to secure a site certificate from the Oregon Energy Facility Siting Council are discussed in Appendix M.

The impacts from pipeline construction would be similar to those of road construction discussed in Section III.C.1 above, except that far less excavation would be required and less land would be utilized (pipeline rights-of-way could require about ten feet of width).

Pipelines constructed above ground could be subject to damage by falling timber if windthrown or cut.

Seismicity may be affected by both the withdrawal of oil and gas and by the reinjection of waste fluids. The withdrawal of petroleum fluids has the effect of reducing formation pressures and may have the effect of decreasing the number and increasing the severity of local earthquakes. Reinjection of waste fluids, particularly along a fault zone, may result in increased fluid pressures at depths which could increase the frequency but decrease the severity of local earthquakes. Considering the low level of seismic activity within the assessment area and Western Oregon in general, however, the likelihood of oil and gas operations triggering earthquakes is considered slight.

Subsidence of the ground surface above an oil and gas reservoir could result from the withdrawal of large volumes of fluids from poorly-consolidated formations charged at greater than hyrostatic pressures. Such subsidence would reach a maximum rate during the production phase. Subsidence occurs infrequently in oil and gas fields. The potential for its occurring within the assessment area is unknown. Should subsidence be detected, the USGS has the authority to require monitoring and the reinjection of fluids into the production zone to halt the subsidence.

Should water in excess of available waste water be needed for reinjection either to counteract subsidence or to stimulate oil recovery, it may be necessary to divert surface water or pump ground water. If diversion of surface water were allowed to reduce stream flows below recommended minimum levels, aquatic habitat could be seriously impaired. Such depletion of flows could result in water temperature increases and oxygen content decreases. Life Forms a.2), a.4)a) and 1.d. (see Section II.G.1.) would be the most seriously impacted. See Section I.B.3. for details of water use regulation by the State of Oregon.

With the establishment and long-term use of storage tanks, flowlines, pipelines and wellhead equipment, the possibility of oil leaks and spills may increase over the exploratory drilling and development phases. (The impacts of such accidents are discussed in Section III.C.3.). Vandalism could also cause spills, leaks or fires.

The potential social and economic impacts of oil and/or gas production are discussed in Section III.C.7. below.

6. Abandonment

When an exploratory well or an entire production lease is abandoned, regulations require that the wells be properly plugged and the sites and roads be restored as nearly as possible to the original condition to standards required by the surface management agency. This restoration should have a beneficial impact upon nearly all components of the environment. Returning the areas to vegetation should reduce erosion potential and accelerate the return of vegetation and a balanced ecosystem to the disturbed areas.

If roads and other sites constructed for oil and gas operations would be useful for future timber managment or recreation access purposes, the BLM and USGS could require that they not be reclaimed.

Abandoned wells converted to water wells (see Section I.B.2.e.) could provide supplies of fresh water useful to wildlife, fisheries and for maintaining stream flows, particularly during dry summer months.

7. Socio-Economic Impacts

The impacts of Federal oil and gas lease issuance, per se, are minimal. Most impacts result from exploration and development activities which follow leasing. Since these activities are relatively poorly defined at this time in terms of specific areas involved, timing and technical detail, assessments of impacts on humans are, of necessity, imprecise. Subsequent assessments which will be prepared before operating plans for exploratory drilling, field development or construction activities can be approved will be able to more closely define likely social and economic impacts.

The assessment presented below considers a range of potential impacts. The probable impacts are quite speculative and depend upon the resource actually discovered, if any, and the future energy market in particular.

a. Employment

New, local job opportunities during the preliminary investigations and exploratory drilling phases will likely be minimal due to the lack of the necessary special skills within the local labor pool. An exploratory drilling crew consists of approximately 20 people of which perhaps 15-30 percent might be hired locally for the 2-3 month period needed to drill an exploratory well. It is unlikely that more than one drilling crew would be working in the area at one time. If new road or pad construction were necessary, short-term employment might be created for local construction workers and firms.

If an economic reserve is discovered, maximum employment would occur during the field development phase. An additional 1-3 drilling crews (20-60 people) could be expected to be added, potentially offering employment to 3-18 local people for a period of several months. Additionally, road, pipeline and other necessary construction work could be done by local contractors and labor if they are competitive with nonlocal contractors.

The direct employment level during the producing life of an oil and/or gas field will be considerably reduced from the development phase (see Section I.B.5.d.7)). It is estimated that from 3-20 people would be required to operate a gas field, depending upon field size. An oil field would necessitate a somewhat greater number. Depending upon the skills available locally (e.g., pump and well maintenance), some of these jobs could be filled locally.

During the abandonment phase, employment will again rise temporarily. Site reclamation work would likely be conducted locally, but well plugging operations may require bringing workmen in from out-of-state for a short period due to the special skills and experience the job requires.

During all phases of oil and gas operations, local employment will be generated indirectly through the provision of services, supplies, lodging, etc.

b. Housing

The influx of nonlocal workers during the preliminary investigation, exploratory drilling, development and abandonment phases will increase demand for temporary housing. This would likely take the form of trailer spaces in trailer courts and apartment space in the existing hotel and motel structures. Such pressure could negatively impact local low-income people who would face increased competition for such housing. To the extent that construction work is contracted locally, especially during the development phase, much of the potential temporary housing pressure would not develop. The increased housing demand may not fall unduly upon the outlying communities due to the proximity of the Eugene-Springfield metropolitan area. The fact that many timber industry workers commute from Eugene-Springfield and Cottage Grove to all locations within the assessment area indicates that oil and gas workers will likely do the same if adequate housing is not available in the outlying areas.

c. Services

The in-migration of temporary workers may cause temporary stress on social and medical services (e.g., school, medical facilities, etc.). However, considering the number of persons involved (see Employment above) and the short duration of most operations (a few to several months), the stress is expected to be accommodated within the existing structure. This would be especially true if the new people reside in the larger communities.

If production is achieved, the estimated 20-30 permanent workers and their families would have to be accommodated. Perhaps one or two additional school teachers, an additional police patrol and an additional sheriff's patrol would be needed. The increased demand for medical services probably would not exceed the capacity of the area's facilities.

Development and production activities would also likely result in more permit actions to be processed through the appropriate administrative offices. Some county roads serving a new oil or gas field might also have to be reconstructed and/or maintained at more frequent intervals.

d. Revenues

Direct revenue from Federal oil and gas leasing and production would accrue to county government through the distribution of receipts from annual rentals and production royalties using the O&C formula.

Annual rentals are $1.00 per acre of which $0.50 would go to the county government. If all Federal lands within the assessment area were leased, the affected O&C counties would receive approximately $42,900 per year whether any further exploration activity occurred or not.

If oil and/or gas production is achieved, the annual rental is replaced by a 12½ percent royalty. Direct county receipts from Federal production royalties will depend upon a number of variables including the size of the field, production rates, well spacing and market values. Although actual receipts could be widely variable, estimates can be made based upon the following "averages" and assumptions:

1) Oil

a) Average daily U.S. oil well production (1973) is 18.3 barrels (bbl) per day. This figure includes stripper wells (approximately 73 percent of the total number of producing wells) which are nearly depleted wells whose income barely exceeds the operating costs of production. Average daily well production by state ranged from 0.3 bbl in Pennsylvania to 1,029.3 bbl in Alaska. California averaged 23.6 bbl per day per well in 1973.

b) The average price of upper tier, "new" oil is $11.00 bbl (March, 1977).

c) Calculations are made assuming a two square mile field (see Appendix M). Using these figures:

i) U.S. royalty per barrel - $1.38

ii) O&C share per barrel - $0.69

iii) Average well would yield O&C counties $12.63 per day or $4,609.95 per year.

iv) A two square mile field would yield O&C counties: 20-acre spacing (64 wells) - $295,040 per year; 40-acre spacing (32 wells) - $147,520 per year; 80-acre spacing (16 wells) -$73,760 per year.

v) On a "per-acre-used" basis (using estimates of total disturbed acres calculated from Appendix G), direct O&C revenue per acre per year for an average well would be: 20-acre spacing (1.4 acres per well) - $3,293; 40-acre spacing (1.7 acres per well) - $2,712.

2) Natural Gas

a) Average well production (1973) is: 175,000 Mcf per year.

b) Average wellhead price is: Interstate (4/1/77) - $1.44 Mcf; Intrastate (late 1976) - $1.80 Mcf.

c) Calculations are made assuming a two square mile field (see Appendix M). Using the above figures:

i) Average wellhead value per year for average well: Interstate - $252,000; Intrastate - $315,000.

ii) U.S. royalty per average well per year: Interstate - $31,500; Intrastate - $39,375.

iii) O&C county share of royalties per year: Interstate $15,750; Intrastate - $19,688.

iv) A two square mile gas field of average wells would yield the O&C counties on an annual basis (intrastate price): 640-acre spacing (2 wells) - $39,375; 320-acre spacing (4 wells) - $78,750; 160-acre spacing (8 wells) - $157,500.

v) On a "per-acre-used" basis using seven acres per well (see Appendix G), direct O&C revenue per acre per year for an average well would be: Interstate - $2,250 per acre; Intrastate - $2,813 per acre.

Indirect revenue will accrue to local and State governments through income taxes, both personal and corporate, and property taxation of oil and gas field installations and transportation facilities. Increased personal income from private royalty payments and oil and gas related employment could represent a major economic benefit should marketable quantities be discovered.

e. Other Factors

Discovery and development of an oil and/or gas field would establish a new industry and thereby help diversify the economies of the affected counties, particularly in the rural portions lying within the assessment area.

A discovery of marketable quantities of oil and/or gas would increase the local energy supply and decrease Oregon's dependence upon imported fuel (both from abroad and from elsewhere in the U.S.). At present, Oregon is 100 percent dependent upon out-of-state sources for its supply of fossil fuels. A commercial discovery would also, to the extent of the size of the resource, relieve pressure upon alternate energy sources (nuclear, additional hydroelectric facilities, coal-fired generating plants, etc.) for future energy development in Oregon.

Development of an oil and/or gas field would require taking small acreages of land out of timber production. When the field is exhausted, the land can be reclaimed, replanted and returned to timber production. During the years of hydrocarbon production, O&C timber revenues would be lost from the affected acreages. A measure of the potential direct revenue loss is given by past O&C revenue figures on a per-acre basis as follows:

County	F.Y. 1975	F.Y. 1976
Lane	$25.98 per acre	$31.12 per acre
Linn	14.77 per acre	17.70 per acre
Douglas	18.92 per acre	22.67 per acre

A comparison of these figures with the estimated direct "per-acre-used" O&C mineral revenues calculated under Revenues above for oil and gas production show that the expected mineral revenue gained exceeds the timber revenue lost by a factor of approximately 100:1.

D. Possible Mitigating Measures

1. Road and Drilling Site Construction

Increased soil erosion and slope failures resulting from construction activities would be similar to those long associated with logging and forest management operations in Western Oregon. It would be appropriate to apply construction practices and considerations similar to those required of forest management construction. Such mitigating measures include, but are not limited to, the following:

a. Existing roads should be used to the maximum extent possible.

b. Prohibit construction involving surface disturbance during periods of heavy rainfall. Such periods frequently occur during the months of October through April.

c. Facilities should be designed to the minimum size which will safely accommodate traffic and equipment for the intended use.

d. Construction design should include facilities to control surface and subsurface drainage, e.g., perforated pipe, water bars and culverts that discharge on stable material.

e. Roads and drill pads should be maintained and those intended for wet season or long-term use should be surfaced.

f. Roads and facility sites no longer needed should be ripped, water barred and revegetated as soon as possible.

g. Road location and design should be such that excavation will not remove support from the base of over-steepened slopes or remove the toe of previous slides.

h. Cuts and fills and exposed banks should be revegetated by seeding and/or mulching.

Surface-disturbing activities, especially road construction, on those slopes shown as critical areas on Map 6 demand specific construction practices and considerations in addition to those enumerated above. Generally, construction should be prohibited, but there may be areas where construction is possible provided specific mitigating measures are taken, including, but not limited to, the following:

i. The side cast of excavated material should be avoided and end haul of such material required especially in steep drainage headwalls.

j. Cut and fill slopes designed to exceed the normal angle of repose should include slope stabilizing measures, e.g., riprap, rock buttresses, bin or retaining walls, piling and horizontal drains.

The chance of sedimentation of surface waters following construction in close proximity to streams and the adverse effects on water temperatures of removing streamside vegetation could be mitigated by requiring the maintenance of a vegetative buffer along the stream bank. Such buffers are particularly important along those streams indicated as fish habitat on Map 7 as well as those tributaries which may affect water quality.

Stream channel relocations should be avoided. If channel change is necessary, it could be designed to minimize increases in water velocity.

To minimize the long-term or permanent loss of growing sites, the impacts of clearing and use for drill pads, tank batteries, pipelines and other facilities could be mitigated by the following measures: (1) removal and stockpiling of top soil to be respread over the site during reclamation; (2) replanting of native vegetation common to the site prior to development; and (3) avoiding disturbance of sites difficult to revegetate, e.g., rocky, shallow soils and steep, southern exposures.

Visual impacts of right-of-way clearing over ten feet in width for road, trail, pipelines or powerlines could be mitigated by the following: (1) use existing rights-of-way to the maximum extent possible; (2) fit right-of-way locations to the topography by using topographic and vegetative features in the design and location to minimize the discordant effect of continuous linear clearings; (3) revegetate all exposed soil on cut and fill slopes and embankments as soon as possible; and (4) reclaim and revegetate with native vegetation rights-of-way no longer needed.

Visual impacts of clearings for seismic exploration, drill pads, tank batteries and other facilities could be reduced by the following: (1) limit the size of each site to the minimum necessary to accommodate the operation; (2) locate clearings so they will be screened from heavily-traveled roads, developed recreation sites and populated areas (especially in areas having high and medium sensitivity); (3) design clearings visible from high- and medium-sensitive roads or developed recreation sites in an irregular pattern in order to present a natural clearing outline; (4) prohibit clearings on exposed skylines; and (5) prohibit clearing and development on steep slopes where extensive excavation is needed to make a level site.

The extent and importance of cultural resources within the assessment area is, in many respects, unknown. Inadvertent destruction of cultural resources can be avoided by requiring a certified, independent survey prior to any operations under terms of an oil and gas lease. The purpose of the survey would be to disclose the existence of antiquities and other objects of historic interest. Once a site is discovered, provisions can be made to avoid it or, if avoidance is not feasible, to salvage the information through controlled scientific excavation.

2. Preliminary Investigation

Geophysical operators could be required to water down roads when their use of such roads would create excessive dust problems.

Vibroseis survey operators could be required to provide warning signs and flagmen when their use of existing roads is likely to create blockages or passage hazards for other vehicles.

3. Exploratory Drilling and Development

In addition to the mitigating measures listed under Road and Drilling Site Construction above, the following can also be identified:

The effect of landsliding and flooding upon oil and gas facilities and the resulting water and soil contamination could be reduced by proper site selection to avoid flood plains and known unstable slopes.

Possible interference with the future productivity of rock quarries could be prevented by prohibiting use of the surface of such sites for well drilling or the installation of permanent or long-term facilities such as tank batteries or pipelines.

Impacts to identified potential recreation sites could be mitigated by prohibiting surface occupancy or controlling such occupancy by specifically-tailored stipulations applicable to an individual site. Stipulations could cover such items as restricting drilling to existing cleared areas, detailing required rehabilitation and perhaps setting a time limit on occupancy of the site.

Surface occupancy of existing recreation sites and adjacent buffer areas could be prohibited, thus avoiding any activities damaging or disruptive to the recreation value of the site.

Surface occupancy of other special-use areas, such as forest nutritional research plots, progeny plantations, known cultural resource sites and proposed research natural areas, could be prohibited.

Diversion of water for drilling operations from streams could be stopped during periods when such diversion would reduce the stream level below recommended minimums.

The impact of noise on visitors to recreation sites and residences near operating oil and gas sites could be mitigated by requiring engine mufflers and housings over flowline pumps.

The visual impact of exploration and production equipment, including drill derricks, storage tanks and pipelines, visible within high- and medium-sensitive areas could be softened by using nonreflective paints that blend with the surrounding landscape.

The disposal of drilling mud could be prohibited if it would be visible from high- and medium-sensitive roads, developed recreation sites or populated areas unless such mud could be mixed into other surface soil and revegetated with native vegetation.

Loss of nest trees used by northern spotted owls, other raptors and great blue herons, as well as snags, could be mitigated by careful selection of locations of roads and construction sites. High-value wildlife sites should be avoided wherever possible. If such areas cannot be avoided, timber falling should be done during the nonnesting season. Construction should be prohibited in timber stands designated as crucial for northern spotted owls unless the District biologist determines that the habitat and the birds themselves can withstand the activities.

Elk harassment within elk concentration areas, as located on Map 8, could be mitigated by controlling vehicular access over newly-constructed roads and trails. This could be accomplished by gating the roads during use for oil and gas activities and by blocking and reclaiming the roadbed when it is no longer needed.

Activities with potential for influencing eagle nest trees should be conducted in accordance with regulations established by the U.S. Fish and Wildlife Service. These regulations prohibit any action that would destroy a nest tree, kill or injure eagles or cause nesting failure.

4. Production and Abandonment

If water needed for reinjection or other production purposes is taken from surface sources, such diversion could be stopped during periods of low flow when such diversion could reduce the stream level below the minimum necessary to sustain normal populations of those species known to inhabit or use the stream.

To reduce the chance of damage to pipelines and flowlines from falling timber, all such installations could be buried.

The effects of oil and gas operation-induced earthquakes, should any occur, could be reduced or prevented by requiring the lessee to monitor seismic activity in the area and to appropriately alter production activity (fluid withdrawal or reinjection).

The impacts of subsidence, should any occur, could be minimized by requiring the monitoring of subsidence and fluid withdrawals and the reinjection of fluids as necessary.

5. Socio-Economic Impacts

Adverse pressures upon local services and housing generated by oil and gas operations, particularly during the exploratory drilling and field development phases, could be reduced or prepared for by BLM maintaining close coordination with local governments so that they have as much advance notice as possible of pending oil and gas operations.

Removal of land from the timber production base, either temporarily or permanently, can be minimized by requiring all cleared areas to be kept to the minimum size necessary to accommodate the planned operation.

E. Recommendations for Mitigation

It is recommended that all measures identified under the preceding section, Possible Mitigating Measures, be implemented. Most of the identified measures can be employed under the following situations:

Upon submission of an application for a permit to drill or a plan of operations, appropriate conditions and stipulations which are tailored to the location and details of the planned operation can be added to the permit or plan. Examples are construction site locations, road construction standards, site reclamation requirements, etc.

Under existing regulatory measures, such as Federal regulations, terms on the lease form, USGS Notices to Lessees, etc. (see Section I.B.6.), the USGS, BLM and State agencies have the authority to, among other things, regulate waste disposal, regulate water appropriation, require the monitoring of seismic and subsidence activity and order remedial actions.

In addition, it is recommended that the following stipulations be used:

1. General Stipulations

It is recommended that all Federal oil and gas leases issued within the assessment area contain the following special stipulations:

a. Prior to any operations under this lease, the Lessee will engage a qualified professional archaeologist, acceptable to the Authorized Officer of the Bureau of Land Management, to make a survey of the land to be disturbed or occupied. A certified statement, signed by the qualified professional archaeologist, setting out the steps taken in the survey and the findings thereof as to the existence of antiquities or other objects of historic or scientific interest, shall be submitted to the Authorized Officer and to the District Engineer, Geological Survey. If the statement indicates the existence of such material which might be disturbed by operations under this lease, the Lessee shall take such mitigating actions as may be required by the Authorized Officer, including, but not limited to, archaeological salvage or protective measures or avoidance of the site to protect and preserve such objects. Such objects shall remain the property of the Lessor or the surface owner if other than the Lessor. If a cultural resource is discovered during project operations, activities will be stopped until a survey of the materials is completed by a qualified professional engaged by the Lessee and acceptable to the Authorized Officer. The Lessee shall take such mitigating actions as may be required by the Authorized Officer, including, but not limited to, archaeological salvage or protective measures or avoidance of the site to protect and preserve the materials. Such materials shall remain the property of the Lessor or the surface owner if other than the Lessor.

b. The Lessee shall contact the Authorized Officer of the Bureau of Land Management prior to development of a plan of operations to be apprised of practices to be followed or avoided in field development, including, but not limited to, such matters as road standards, stream crossings, gates, erosion control, surface rehabilitation and maintenance.

The types of practices which the Authorized Officer will consider are included in Appendices K and L. Which practices will be appropriate to a given operation depends upon the specific field location of the operation. However, it is felt desirable that all parties be familiar with some of the types of practices that will be considered to establish a basis of communications and understanding.

c. In order to minimize watershed damage during muddy and/or wet periods, the Authorized Officer of the Bureau of Land Management, through the District Engineer, Geological Survey, may prohibit construction, movement of heavy equipment, and/or other activities which could result in excessive surface disturbance.

d. No occupancy or other surface disturbance will be allowed on slopes in excess of 45 percent without written permission from the District Engineer, Geological Survey, with the concurrence of the District Manager, Bureau of Land Management.

e. The Authorized Officer of the Bureau of Land Management, through the District Engineer, Geological Survey, may prohibit well drilling and installation of storage or treatment facilities for crude petroleum within natural flood plains.

f. When clearing, occupying or operating within close proximity to a perennial stream, Lessee shall maintain vegetative buffer zones. The design of said buffer zones shall require the approval of the District Engineer, Geological Survey, with the concurrence of the Authorized Officer of the Bureau of Land Management.

g. The Lessee agrees that, during the life of his lease, he shall comply with all applicable State and Federal laws and regulations concerning the use of pesticides, including insecticides, herbicides, fungicides, rodenticides and other similar substances. Prior to the use of such pesticides on the lease area, the Lessee shall obtain approval of a written plan from the Authorized Officer, Bureau of Land Management, with the concurrence of the District Engineer, Geological Survey. The plan shall state the type and quantity of material to be used, the pest to be controlled, the method of application and such information as the Authorized Officer may require. All use of pesticides on the lease area shall be in accordance with the approved plan. If the use of a pesticide is prohibited by the Secretary of the Interior, it shall not be used.

h. No surface occupancy of developed quarry sites will be allowed without written authorization from the District Engineer, Geological Survey, with the concurrence of the Authorized Officer of the Bureau of Land Management.

2. Site-Specific Stipulations

The following stipulations are recommended for use in any Federal oil and gas lease issued which contains any of the specific lands described below:

a. Surface occupancy of the 1 Progeny Plantation is prohibited. Said plantation is located in a portion of the 2, Will. Mer., and includes an area of approximately 3 acres.

1	2	3
Middle Fork	W½NW¼ Sec. 25, T. 23 S., R. 2 W.	15
Mt. June	NW¼ Sec. 31, T. 20 S., R. 1 E.	15
Martin Creek	NW¼ Sec. 31, T. 22 S., R. 2 W.	15

b. Surface occupancy of the Regional Forest Nutritional Research Study Installation No. 63 is prohibited. Said installation is located in a portion of the NW¼NW¼ Sec. 23, T. 20 S., R. 1 W., Will. Mer., and includes an area of approximately ten acres.

c. Surface occupancy of the Sharps Creek Recreation Site and those lands within 500 feet of the developed perimeter of said site is prohibited. Said site is located in portions of Lots 3 and 4 of Sec. 15, T. 22 S., R. 1 W., Will. Mer., and includes an area of approximately 40 acres.

d. Prior to any surface occupancy of the S½ Sec. 35, T. 23 S., R. 2 W., Will. Mer., Lessee shall develop, with the cooperation of the Bureau of Land Management, an occupancy and development plan. The purpose of such a plan is to preserve the unique characteristics of said area for future recreation development.

e. Surface occupancy of the proposed Research Natural Area, located in T. 19 S., R. 4 W., Sec. 25, NE¼SW¼NE¼NW¼, S½SW¼NE¼NW¼, SE¼NE¼NW¼, W½E½NW¼NW¼, W½NW¼NW¼, SE¼SE¼NW¼NW¼, S½NW¼, N½SW¼, SW¼SW¼, W½NE¼SE¼SW¼, NW¼SE¼SW¼, N½SW¼SE¼SW¼, SW¼SW¼SE¼SW¼, W½NW¼NW¼SE¼, NW¼SW¼NW¼SE¼, is prohibited. Said natural area includes an area of approximately 280 acres.

F. Residual Impacts

Seismic survey operations may cause temporary forest road blockages.

Geologic hazards triggered by natural forces could damage oil and gas field facilities and cause oil spills, mud pit breaches, failures of road fills and other environmental problems during all phases of operations. Landslides could impact field operations if roads, well sites or other facilities were located on or below unstable slopes.

Land would be temporarily and/or permanently removed from timber production. The amount will vary directly with the degree of oil and gas operations and could become significant if a field is discovered and developed.

Dust from road construction and road use during drier seasons could have a localized adverse effect on air quality.

Smoke from slash fires associated with clearing operations, though controlled to the degree possible by the State of Oregon, could cause a temporary degradation of air quality.

Accidents (e.g., blowouts, fires, oil spills and dike breaches) or vandalism could increase erosion through destruction of vegetation, contaminate surface waters, sterilize soils and temporarily degrade air quality by the discharge of odorous and toxic natural gases. Oil fires emit smoke and the products of hydrocarbon combustion into the atmosphere.

Accidents (e.g., blowouts, fires, oil spills and dike breaches) or vandalism could destroy vegetation and contaminate surface waters resulting in the destruction of wildlife habitat and the killing of numerous animals including both terrestrial and aquatic species. The aquatic habitat is particularly sensitive to the toxic, water-soluble fraction of crude oil which can continue to be released for some time from contaminated stream bottoms.

Noise and activity associated with seismic surveys, road construction, drilling and well operation will disturb terrestrial wildlife species within the more immediate vicinity of such operations.

Any fires which might result from oil and gas operations could create visible scars upon the landscape depending upon location and size.

Information gathered during the first three stages of oil and gas operations may further the knowledge of the stratigraphy, structure and geologic history of the region and may aid future evaluations of mineral and fuel potentials.

Additional road construction associated with exploration and development could also be used for timber management and recreation access.

Clearing of forested areas for roads, well sites, storage tank areas and other facilities will have a favorable impact upon species of wildlife that utilize forest openings, especially after the abandonment phase.

Discovery of previously unrecorded archaeological sites during the exploration and development phases of petroleum operations is a very real possibility. Construction of roads, drill pads and other facilities will necessitate the removal of vegetative cover from areas previously hidden from view. The uncovered areas will facilitate the search for archaeological resources.

Exploration and development operations may create some local employment opportunities, at least on a temporary basis.

Exploration and field development operations will bring new people into the area, at least on a temporary basis, and will increase demand for temporary housing and local governmental and social services.

Increased personal income from royalty payments and increased county revenue from shared royalties and new tax sources represent a major economic benefit from oil and gas development should marketable quantities be discovered.

Despite all feasible precautions, some oil and gas operations or accidents which destroy vegetation, disturb the soil, expose bedrock, or degrade water quality could cause some adverse disruption of ecological interrelationships. The relatively small area that is anticipated to be disturbed by oil and gas operations or accidents would probably have little overall effect on the ecosystem of the entire assessment area.

IV. ASSESSMENT OF ALTERNATIVES

A. No Leasing

Adopting the alternative of "no leasing" would prevent any adverse environmental impacts on public lands of a localized or on-site nature as described under Anticipated Impacts (Section III.C.), i.e., impacts from drill pad construction, etc. However, adopting this alternative would not necessarily preclude resource development. Because of the checkerboard ownership, oil and gas development could proceed on private lands and could indirectly impact public lands in components of the environment that are of a transient or off-site nature. Following are a few examples of the types of impacts on public lands that might be incurred from oil and gas activities on private lands:

1. Air Quality

All lands downwind from the point where pollutants are entering the air could be affected to some degree.

2. Water Quality

The same analogy holds here. All lands downstream from the point of contamination could be affected, regardless of land ownership.

3. Landscape Character

If the field of view includes private lands under development as well as public lands, there could be visual impacts.

4. Socio-Economic Interests

There would be a loss in revenue to the county and Federal government as drainage of oil and gas underlying public land may occur through wells located on intermingled private lands.

5. Ecological Interrelationships

These interrelationships, not being confined to property lines, could be impacted on nearby public lands.

A more detailed description of specific impacts is given in Section III.C.

There are other impacts that could result from adopting a "no leasing" position that should also be considered. It is likely that roads across public lands would be used for access to private holdings. Although existing roads would probably be used whenever possible, there is a possibility of constructing new roads. Draining an oil or gas reservoir from only private lands could result in inefficient resource recovery. This could cause a portion of an energy resource to be unrecoverable. Overlooking any oil and gas resource could lead to (1) increased reliance on other energy sources, (2) mandatory conservation, (3) energy shortages and (4) extra costs of importing energy.

It should be brought out that to simply deny leasing would be in contrast to national policies urging energy independence for the United States. In addition, the Bureau of Land Management cannot arbitrarily deny leasing. Laws, regulations and court decisions dealing with oil and gas leasing dictate that denial requires cause and denial for cause assumes an objective evaluation. Such is one purpose of this environmental assessment - to ponder the significance of residual environmental impacts (those that remain after all resonable mitigating measures are applied) to determine if there is justification for a recommendation of denial. Denial, therefore, is a possible environmental consideration in the process of deciding whether to lease or not to lease.

B. Leasing Under No Controls Other Than Those Required by Law or Regulation

If this alternative was adopted, the controls over oil and gas operations on public lands would be limited to those required by law or regulation as summarized in Section I.B.6. Such existing regulatory authority does, however, provide extensive control over lessee activities. Nevertheless, during the formulation of an oil and gas lease under this alternative, none of the proposed conditions and stipulations developed under Recommendations for Mitigation (Section III.E.) would become a part of the lease. As a result, the anticipated impacts on the environment that those proposed stipulations and conditions were designed to mitigate may be left unchecked. The unchecked impacts would be particularly noticeable in areas designated for "no surface occupancy" under the proposed action, i.e., recreation sites, progeny test plots, rock quarries.

Adopting this alternative would probably induce a favorable impact by decreasing operating costs for the lessee. This could be accomplished by speeding up lessee's operations, by reducing the number of delays, paperwork and compliance work. Reducing the amount of paperwork and compliance work could also lower the Government cost of administering the lease.

V. RELATIONSHIP BETWEEN SHORT-TERM USE AND LONG-TERM PRODUCTIVITY

Generally, the ecosystems within the assessment area are highly productive and in good equilibrium. The extent of resource commitments and an assessment of the environmental impacts associated with oil and gas leasing have been described in the preceding sections. Except for these commitments and their short-term environmental effects, little impact on long-term productivity would be expected.

The exploration phase of oil and gas leasing would result in a short-term use of public lands. Where such exploration proves unsuccessful, there would not be further use of the lands for resource production. Under such circumstances, a lease would terminate at the end of its ten-year primary term unless sooner relinquished by the lessee or canceled for noncompliance.

Where exploration discovers an economically attractive oil or gas resource, development and production would be expected to occur. The production phase would probably continue for several decades until the reserves were depleted. When the reservoir was depleted, the lease would terminate, facilities would be dismantled and the land restored, insofar as possible, to its original condition.

Because Western Oregon ecosystems are generally quick to recover from both natural and man-made abuse, planned site reclamation is expected to be successful. Any loss in long-term productivity would most likely be limited to small, scattered acreages (1) accidentally subjected to contamination during drilling or production; or (2) subjected to loss of topsoil by construction-related erosion or landslides. Production and depletion of an oil and/or gas field in the short term would preclude long-term future use of the reserves for energy or as raw material in manufacturing processes.

VI. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

If oil and gas are discovered and produced, the major irreversible impact would be the extraction of oil and/or gas from the geologic formations and the resulting reduction of natural reserves. In addition, there would be the irretrievable consumption of natural construction materials, such as sand and gravel, for the development of the field.

The loss of soil through erosion from exposed surface areas represents an essentially irretrievable commitment of the resource. While soil formation is a continuing process, the time periods involved are so long that the loss can be considered essentially irreversible. The quantity of soil loss would be dependent upon the effectiveness of the mitigation measures discussed above.

There is a possibility that accidents may occur in spite of precautions taken. If ground water aquifers were contaminated by accidents in drilling operations, water quality may be impaired for long periods of time.

Other significant irreversible commitments stem primarily from the "what if" side of the ledger. For example, massive earth slides triggered by seismic activity could cause excessive stream siltation and create permanent marks on the landscape. Subsidence could alter aquifers, impairing permeability and the quantity of subsurface waters. The likelihood of either event is not well known. We can presume, if very tentatively, based upon limited geologic knowledge, that the probabilities would be low.

VII. INTENSITY OF PUBLIC INTEREST

The proposed oil and gas leasing program for public lands within the assessment area has raised a moderate amount of public input.

Sixty letters requesting technical input or any other comments on the environmental effect of proposed leasing were sent to interested Federal, State and local agencies, interest groups and individuals. We received replies from 17 of those directly solicited. In addition, local newspapers and radio and television media were sent news releases and provided news coverage which resulted in no additonal public comments.

To date, the comments received range from approval of the proposed leasing, to concern for specific environmental and resource values, to requests for further information and copies of the assessment report when completed.

VIII. PERSONS, GROUPS AND GOVERNMENTAL AGENCIES CONSULTED

During March 1977, letters were sent to the following agencies, persons and groups inviting comments on the effect of oil and gas leasing on the environment of the assessment area:

A. Federal Agencies

Bureau of Reclamation
Pacific Northwest Region
Boise, Idaho

Bonneville Power Administration
Portland, Oregon

Office of Federal Affairs
Environmental Protection Agency
Seattle, Washington

Federal Energy Administration
District Office
Portland, Oregon

U.S. Fish & Wildlife Services
Ecological Services Division
Portland, Oregon

Soil Conservation Service
State Conservationist
Portland, Oregon

U.S. Soil Conservation Service
Eugene, Oregon

Hon. Bob Packwood
U.S. Senate
Washington, D.C.

Hon. James Weaver
House of Representatives
Washington, D.C.

Hon. Mark Hatfield
U.S. Senate
Washington, D.C.

B. State Agencies

State Clearinghouse
Oregon Project Notification and Review System
Intergovernmental Relations Department
Salem, Oregon

Oregon Department of Geology and Mineral Industries
State Geologist
Portland, Oregon

Oregon Department of Fish and Wildlife
Environmental Management Section
Portland, Oregon

C. Local Government Agencies

Cottage Grove City Manager
Cottage Grove, Oregon

Eugene City Manager
Eugene, Oregon

Springfield City Manager
Springfield, Oregon

City of Sweet Home
Sweet Home, Oregon

City of Lowell
Lowell, Oregon

Lane Council of Governments
Lane County Courthouse
Eugene, Oregon

Lane County Board of
Commissioners
Lane County Courthouse
Eugene, Oregon

Linn County Planning Commission
Albany, Oregon

City of Veneta
Veneta, Oregon

Board of Commissioners
Linn County Courthouse
Albany, Oregon

Lane County Planning Division
Environmental Management
Department
Eugene, Oregon

Lane Regional Air Pollution
Authority
Eugene, Oregon

D. Groups and Individuals

Oregon Historical Society
Portland, Oregon

League Of Women Voters of
Central Lane County
Eugene, Oregon

Dr. Ewart M. Baldwin
Department of Geology
University of Oregon
Eugene, Oregon

Northwest Steelheaders Assn.
Eugene, Oregon

American Fisheries Society
Portland, Oregon

Oregon Wildlife Federation
Nyssa, Oregon

Oregon Environmental Council
Portland, Oregon

ASUO Survival Center
University of Oregon
Eugene, Oregon

Upper Willamette RC&D
Eugene, Oregon

Association of Oregon
Archaeologists
Department of Anthropology
University of Oregon
Eugene, Oregon

Dr. David Cole
Museum of Natural History
University of Oregon
Eugene, Oregon

Izaak Walton League of America
Eugene, Oregon

Oakridge Audubon Society
Westfir, Oregon

1000 Friends of Oregon
Portland, Oregon

Sierra Club, Eugene Chapter
Eugene, Oregon

Environmental Studies Center
University of Oregon
Eugene, Oregon

Corvallis Center for Environmental Services
Oregon State University
Corvallis, Oregon

Committee of Women on the Environment
Eugene, Oregon

Nature Conservancy, Northwest Office
Portland, Oregon

Friends of the Earth, Inc.
San Francisco, California

Northwest Environmental Defense Center
Portland, Oregon

Mr. John W. Batts
Billings, Montana

Lane County Chamber of Commerce
Coburg, Oregon

Springfield Chamber of Commerce
Springfield, Oregon

Timber Operator's Council, Inc.
Eugene, Oregon

Upper Willamette Timbermen's Association
Creswell, Oregon

Oregon Student Public Interest Research Group
Portland, Oregon

Oregon Representative Wilderness Society
Eugene, Oregon

Oregon Cascades Conservation Council
Portland, Oregon

Mobil Oil Corporation
Los Angeles, California

Western Oil and Gas Association
Los Angeles, California

Eugene Chamber of Commerce
Eugene, Oregon

Western Forest Industry Association
Corvallis, Oregon

Industrial Forestry Association
Eugene, Oregon

Northwest Timber Association
Eugene, Oregon

Natural Resource Director
Associated Oregon Industries
Salem, Oregon

IX. PARTICIPANTS

This Environmental Assessment Record was prepared by BLM personnel in the Eugene District with technical assistance and information supplied by the following:

John L. Andrews - Oregon Department of Fish and Wildlife
W. H. Christianson - Oregon Department of Fish and Wildlife
David L. Cole - Museum of Natural History, Univ. of Oregon
Edward T. Long - State Historic Preservation Office
Vernon C. Newton, Jr. - Oregon Department of Geology and Mineral Industries
William R. Patching - Soil Conservation Service

The BLM, Eugene District, interdisciplinary team was:

Ronald E. Bramble - Outdoor Recreation Planner
George R. Chalfant - Soil Scientist
Alan Curtis - Forester
Oren B. Erickson - Landscape Architect
Russel A. Hammer - Fishery Biologist
Jerald L. Jones - Geologist
Alan D. Schaffer - Realty Officer
Michael D. Southard - Archaeologist
Charles L. Thomas - Wildlife Biologist
Ronald O. Wold - Geologist

X. SUMMARY CONCLUSION

On the assumption that recommended mitigating conditions and stipulations will be appropriately required, there are no major residual, environmental impacts anticipated from the proposed action. Obviously, accidents could result in the contamination of surface waters, soil sterilization and the destruction of vegetation - such could effect wildlife habitat and numerous animals including both terrestrial and aquatic species. Though recent exploration and development history shows a low accident rate, the potential environmental impact resulting from an accident must be considered.

Because Western Oregon ecosystems are generally quick to recover from both natural and man-made abuse, planned site reclamation would most likely be successful. Any loss in long-term productivity would probably be limited to small, scattered acreages accidentally subjected to contamination during drilling or production.

If development of an oil and gas field takes place, the improvements and impacts on the land would last for many years. After depletion of the resource, improvements would be removed and reclamation would be initiated.

It is unlikely that activity beyond the exploration stage will occur on the majority of acres under lease application. Exploration has the least environmental impact of the stages of oil and gas development. The site of past exploration is difficult for most and impossible for many to locate after just a few years following abandonment and reclamation.

XI. SIGNATURES

Ronald O. Wold
Ronald O. Wold
Interdisciplinary Team Leader

November 28, 1977
Date

Jon H. Strandjord
Jon H. Strandjord
Environmental Coordinator

November 28 1977
Date

James P. Clason
James P. Clason
Chief, Division of Resources
Eugene District

November 28, 1977
Date

APPENDIX A

Lands Included in Oil and Gas Lease Applications
Mohawk-Dorena Environmental Assessment Area

OR 16177
T. 20 S., R. 3 W., Will. Mer.
Sec. 17: N½, NE¼SE¼
31: S½SW¼

T. 20 S., R. 4 W., Will. Mer.
Sec. 23: W½W½, SE¼SW¼
25: SE¼SW¼

OR 16178
T. 21 S., R. 2 W., Will. Mer.
Sec. 7: SW¼NW¼
17: NW¼NE¼, SW¼SW¼
19: SE¼SE¼
29: All
31: NE¼NE¼

T. 21 S., R. 3 W, Will. Mer.
Sec. 13: W½SW¼
23: E½, NW¼, E½SW¼, SW¼SW¼
25: All

OR 16179
T. 21 S., R. 3 W., Will. Mer.
Sec. 17: SW¼, S½SE¼
19: E½W½, E½

T. 21 S., R. 4 W., Will. Mer.
Sec. 23: W½, SE¼, W½NE¼
25: All

OR 16182
T. 22 S., R. 3 W., Will. Mer.
Sec. 1: Lots 6, 7, SW¼, S½NW¼
2: Lot 1
11: All
15: All

OR 16183
T. 22 S., R. 3 W., Will. Mer.
Sec. 3: S½SW¼, E½NW¼, E½
9: E½
17: SE¼SE¼
19: N½NW¼, SE¼NW¼, N½SW¼, SW¼SW¼, Lot 2
21: E½, SW¼, S½NW¼, NE¼NW¼

OR 16184	T. 22 S., R. 3 W., Will. Mer.	Sec. 31:	Lots 1, 2, NW¼, SW¼NE¼, W½SE¼, E½SW¼
	T. 23 S., R. 3 W., Will. Mer.	Sec. 23:	All
OR 17310	T. 23 S., R. 3 W., Will. Mer.	Sec. 1:	S½, S½N½, Lots 1, 2, 3, 4
		3:	NE¼
		11:	Lots 8, 9, 10
		13:	All
		15:	E½, SW¼, Lots 1, 2, 3, 4
OR 17311	T. 22 S., R. 3 W., Will. Mer.	Sec. 7:	W½SW¼
		33:	NE¼, N½SE¼, NE¼SW¼, Lot 7
	T. 22 S., R. 4 W., Will. Mer.	Sec. 23:	N½, SE¼, N½SW¼, SE¼SW¼
		25:	N½, N½SE¼, SE¼SE¼
	T. 23 S., R. 3 W., Will. Mer.	Sec. 5:	W½W½, SE¼SW¼
	T. 23 S., R. 4 W., Will. Mer.	Sec. 1:	N½, SE¼, N½SW¼, SE¼SW¼
OR 17312	T. 22 S., R. 3 W., Will. Mer.	Sec. 4:	Lot 1
		23:	All
		25:	Lots 3, 4, W½, W½SE¼
		27:	All
		35:	Lots 1, 2, 3, 4, N½, N½S½
OR 17313	T. 23 S., R. 3 W., Will. Mer.	Sec. 9:	Lots 2, 3, 4, N½S½, S½NW¼, SW¼NE¼
		17:	SW¼, W½NW¼, SE¼NE¼
	T. 23 S., R. 4 W., Will. Mer.	Sec. 11:	E½SE¼, NW¼SE¼, E½NE¼, SW¼NE¼
		13:	S½, NE½, S½NW¼
		14:	SE¼SE¼
OR 17456	T. 14 S., R. 3 W., Will. Mer.	Sec. 2:	Lots 1, 2
		3:	Lots 3, 4
OR 17457	T. 15 S., R. 3 W., Will. Mer.	Sec. 20:	Lots 1, 2

OR 17115
T. 18 S., R. 8 W., Will. Mer.
Sec. 25: All
27: All
35: N½, N½S½, SE¼SE¼

OR 17424
T. 18 S., R. 7 W., Will. Mer.
Sec. 15: Lots 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16
17: E½, NW¼, NE¼SW¼, SW¼SW¼

OR 17425
T. 18 S., R. 6 W., Will. Mer.
Sec. 19: Lots 1, 2, 3, 4, E½, E½W½
21: NE¼NE¼, W½E½, W½
23: S½SW¼, S½NE¼SW¼, NE¼NE¼SW¼, S½NW¼SW¼, NW¼NW¼SW¼

APPENDIX B

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

'72 OCT 20 PM 1:03
PSC MAILROOM

October 6, 1972

ORDER NO. 2948

Subject: Division of Responsibility Between the Bureau of Land Management and the Geological Survey for Administration of the Mineral Leasing Laws - Onshore

Sec. 1. Purpose. The purpose of this Order is to set forth the administrative and management procedures for Departmental onshore mineral leasing and operating activities. The spirit and intent of this Order flow from the Department's mineral management objectives of: orderly and timely resources development, protection of the environment, and receipt of fair market value for leased mineral resources.

Sec. 1(a) Orderly and Timely Resource Development includes the Department's responsibilities to:

(1) Foster, promote, and encourage the exploration for and the production of the mineral deposits from the leasable lands; promote competition;

(2) Encourage the active development of the mineral deposits in the leasable lands in a manner compatible with the use of the same lands for other purposes; assure that mineral developers receive the acreage necessary for economic plant investment, development, and production;

(3) Encourage the maximum ultimate recovery of the mineral deposit; prevent waste; promote the conservation of the mineral resources;

(4) Assure adequate minimum production and diligent development requirements for mineral deposits.

(b) Protection of the Environment includes the Department's responsibilities to:

(1) Assure that mineral exploration and production be conducted with the maximum protection of the environment;

(2) Assure the rehabilitation of disturbed lands;

(3) Assure that precautions are taken to protect public health and safety; and

(4) Assure full compliance with the spirit and objectives of the National Environmental Policy Act of 1969, other Federal environmental legislation, and supporting Executive Orders and regulations.

(c) Receipt of Fair Market Value for Leased Mineral Resources includes the Department's responsibilities to assure the public a fair market value return for the use of public lands and the disposition of its mineral resources.

Sec. 2. Agency Responsibilities. The BLM exercises at the Bureau level the Secretary's discretionary authority to determine whether or not leases, permits, and licenses are to be issued. The Bureau of Land Management is responsible for issuing mineral leases, permits, and licenses, and is the office of record in mineral leasing matters. The Geological Survey is responsible for all geologic, engineering, and economic value determinations for the Department's mineral management program. These determinations include: the mineral characteristics of lease and permit areas; parcelling; amounts of bonds; royalties; unit values; rentals; mineral resource evaluations; reserves; investment, diligent development, and minimum production requirements; and all other terms and conditions relating to mineral operations under leases and permits. Geological Survey exercises the Secretary's delegated authority regarding operations conducted within the area of operation by permittees, lessees, and licensees and determines the actions to be taken by them from the standpoint of the development, conservation, and management of mineral resources under the jurisdiction of the Department. GS will refer to BLM any instances of noncompliance with lease terms requiring cancellation action, and BLM will inititate the necessary action.

For the purpose of this Order, the area of operation is defined as that area of the present and planned mine, oil and gas field, or geothermal resource field exploratory, development, and production operations, as presented in an approved exploration or mining plan, drilling permit, oil, gas, or geothermal field development plan, or plan for the abandonment of wells or operations. The area of operation may cover a fraction of a lease or permit area, or it may cover several lease or permit areas. It encompasses the general area needed for storage piles, spoils piles, tailings ponds, on-project mill sites, flow lines, separators, surge tanks, storage tanks, on-project truck or rail-loading stations, drill pads, mud pits, workshops, compressors, generators, on-project power plants, and other such facilities used for on-project mine, oil and gas field, or geothermal resource field exploratory, development, and production operations.

(a) Environmental Protection. The Bureau of Land Management, in cooperation with the Geological Survey, formulates the general requirements to be incorporated in leases, permits, and licenses for the protection of the surface and non-mineral resources and for reclamation. The Geological Survey, before approving exploration and mining plans, drilling permits, oil, gas, or geothermal field development plans, or plans for the abandonment of wells or operations, consults with the Bureau of Land Management on the adequacy of the surface use, environmental protection, and reclamation aspects of the plans and will not grant approval if inconsistent with the BLM's recommendations without further discussions with BLM. If differences remain after these further discussions, the resolution is made by the Assistant Secretary--Mineral Resources and the Assistant Secretary--Public Land Management. If required, the Under Secretary resolves any remaining differences. The BLM is responsible for compliance examinations of environmental protection requirements outside the operating area and for reporting infractions to the GS for discussions with, or orders to, the permittee, lessee, or licensee. GS examines operations to ensure compliance with environmental protection and rehabilitation requirements inside the operating area. With respect to approval of access roads, pipelines, utility routes and other surface uses outside the operating area, the Bureau of Land Management has the primary responsibility but obtains the recommendations of the Geological Survey before taking final action. Orders to operators for any remedial action is the responsibility of the Geological Survey.

(b) Expertise. The Geological Survey is responsible for maintaining engineering, geologic, geophysical, economic, and other technical expertise needed by the Department to assure compliance with applicable laws, operating regulations, and the objectives of the Department's mineral management program. The Bureau of Land Management is responsible for maintaining expertise needed by the Department for action on applications filed with BLM under the mineral leasing laws to assure compliance with applicable laws, leasing regulations, and the objectives of the Department's mineral management program.

(c) Contacts with Applicants.

(1) Prior to the issuance of mineral leases, permits, and licenses, the Bureau of Land Management will represent the Secretary in dealing with applicants.

(2) After issuance and during the exploration, development, and production phases of leases, permits, and licenses, and until a lease, permit, or license has terminated (at which time management is the sole responsibility of BLM) the Geological Survey is the sole representative of the Secretary in all matters relating to the supervision of operations.

Sec. 3. Issuance of Mineral Leases, Permits, and Licenses.

(a) Applications. Prior to the issuance of mineral prospecting permits, leases, or licenses, the Bureau of Land Management refers all applications for such permits, leases, or licenses to the Geological Survey for a report as outlined in (b) below.

(1) The Geological Survey is responsible for determining, under the mineral leasing laws and regulations, if sufficient information is known about a mineral deposit to warrant offering the deposit for lease by competitive sale and to notify the Bureau of Land Management of its determination. If the Geological Survey finds that sufficient information is not available to warrant competitive leasing, it notifies the Bureau of Land Management of its conclusions so that the Bureau of Land Management may issue a prospecting permit or noncompetitive lease, as appropriate. The Geological Survey establishes prospecting requirements for prospecting permits. When lands are to be leased, the Geological Survey determines and reports, as appropriate, on: the mineral characteristics of lease and permit areas; parcelling; amounts of bonds; royalties; unit values; rentals; mineral resource evaluations; reserves; investments; diligent development and minimum production requirements; and all other terms and conditions pertaining to lease operations, including environmental and surface rehabilitation stipulations relating to mineral exploration and extraction. With respect to applications for licenses, the Geological Survey determines and reports as to whether the license may be issued.

(2) The Geological Survey is responsible for determining whether a prospecting permittee has demonstrated that the lands contain a mineral deposit having the characteristics required by law and regulations to qualify for a preference right lease and to notify the Bureau of Land Management.

(3) The Bureau of Land Management refers to the Geological Survey all other type applications received which, if approved, may affect operations on existing permits, leases, or licenses.

(4) The Bureau of Land Management notifies the Geological Survey of known oil, gas, and geothermal resource geophysical exploration activity, including the area involved, the type of survey employed, and the name of the operator.

(5) All applications for noncompetitive oil and gas, mineral, and geothermal resource leases filed with the Bureau of Land Management will, prior to issuance of a lease, be referred to the Geological Survey for a determination as to whether the lands are within a known geologic structure (KGS), a known geothermal resource area (KGRA), or a known leasing area (KLA).

(b) Mineral Resource Evaluation Report. GS is responsible for submitting a report of its findings, mineral resource evaluations, and resultant recommendations to the BLM, together with a summary explanation of how the resource evaluations were developed from geophysical, geologic, economic, and engineering data available at the time of the evaluation. The BLM reviews these findings and recommendations in light of multiple-use management requirements and will not issue leases or permits inconsistent with the findings and recommendations without further discussion with GS. If differences remain after further discussion, the resolution is made by the Assistant Secretary--Mineral Resources and the Assistant Secretary--Public Land Management. If required, the Under Secretary resolves any remaining differences.

(c) Competitive Lease Sales. The Bureau of Land Management advertises and conducts competitive lease sales. The Geological Survey's resource evaluations will be used and the Geological Survey will have representatives at the sale and renders a post-sale recommendation to BLM regarding acceptance or rejection of the bids, which must be confirmed in writing.

(d) Files and Records. BLM maintains the official application, permit, and lease case files and forwards to the Geological Survey a copy of each permit, lease, and license, together with copies of relevant correspondence thereafter conducted by the Bureau. The GS forwards to the BLM copies of mining and exploration plan applications, drilling permit applications, and relevant items submitted by the applicants directly to the GS, except confidential proprietary information cited under paragraph (e) below.

(e) Security of Information. The Geological Survey is responsible for receiving and protecting for the confidential use of the Federal Government all proprietary geological, geophysical, engineering, economic, statistical, or other information, mineral resource data, and well logs required to be submitted under Title 30 CFR, Parts 200, 211, 216, 221, 231, 270, and related regulations. The Survey Office receiving such information is designated the Office of Control for those data. Authorized officials of BLM or other surface-managing agencies having a need to see such information will normally make appropriate arrangements to visit the Office of Control for access to such data and for technical advice based on it pertinent to their management responsibilities.

Sec. 4. Mineral Reports. The Geological Survey is responsible for preparing and submitting to the Bureau of Land Management mineral classification and evaluation reports with respect to the leasable mineral value of lands within proposed exchanges, withdrawals, sales, land entries, or other disposals and all other land transactions. The Geological Survey, upon request, also prepares and furnishes mineral reports and other information to the Bureau of Land Management needed for its use in long-range multiple-use planning or inventory of the public lands.

Sec. 5. General Relationships. Such additional references, reports, interchange of information, and advice shall be made by or between the Bureau of Land Management and Geological Survey as may be necessary to perpetuate or improve current practice and provide effective administration of the mineral leasing laws.

The Bureau of Land Management and the Geological Survey must submit to each other for review and recommendations any proposed changes in standard lease terms, regulations, instructions, or other changes that would affect each agency's management responsibilities.

Sec. 6. Implementation of Order. It is intended that there will be no duplication by the BLM or GS of the functions assigned by this Order. BLM and GS will promptly bring their manuals and instructions into agreement with the terms and the spirit and intent of this Order.

Sec. 7. Revocation. The Secretary's instruction (procedures relating to the administration of the mineral leasing laws - General Land Office and Geological Survey) dated September 22, 1925 (51 L. D. 219) is revoked.

OCT - 6 1972

Rogers C. B. Morton

Secretary of the Interior

B- 7

COOPERATIVE PROCEDURES PERTAINING TO ONSHORE OIL, GAS, AND GEOTHERMAL RESOURCES

IMPLEMENTATION OF SECRETARIAL ORDER NUMBER 2948

COOPERATIVE PROCEDURES

These procedures provide for the mutual cooperation between US Geological Survey (GS) and the Bureau of Land Management (BLM) concerning oil, gas, and geothermal resources operations in accordance with Secretarial Order No. 2948.

The designation of BLM in this agreement shall refer to the responsibilities of the BLM District Managers in the Western States or to the Director of the Eastern States Office, as applicable.

The designation of GS in this agreement shall refer to the responsibilities of the District Engineers, the Alaska Area Oil and Gas Supervisor, the Western Area Geothermal Supervisor, and in some instances, the Eastern Area Oil and Gas Supervisor, as applicable.

This agreement pertains to the cooperative procedures between the two bureaus with respect to oil, gas, or geothermal resources operations conducted within an area of operation on those leases where BLM is the responsible surface managing agency or where reserved minerals are involved.

In the event of a conflict between special lease stipulations and the instructions herein contained, this agreement shall prevail. With only those exceptions herein specified, the GS shall be the sole representative of the Secretary with respect to direct contact with the lessees and operators in matters related to operations as specified in Section 2(c)(2) of Secretarial Order No. 2948.

For the purpose of this working agreement, the Area of Operation (AO) shall be outlined on the map attached to the approved plan of operations. Such AO will involve joint GS/BLM management roles and responsibilities. Operations on that portion of the AO involving exploration, development and production of the leased mineral deposit shall be the exclusive jurisdiction of the GS. All other uses not appurtenant to the mineral operations will be the exclusive jurisdiction of the BLM. The following general guidelines are provided to describe the exterior boundaries of an AO:

1. For an exploratory well: For wells two miles or more from the nearest producing well, the AO shall be established as 160 acres if it is an oil or geothermal resources test and 640 acres if a a gas test.

2. For a producing field: For wells within or adjacent to producing fields, the AO shall embrace the actual acreage then spaced for production from the target reservoir plus, if necessary, the spacing unit for the well then under consideration. For wells outside the established productive limit of a field but within two miles thereof, the AO shall be the same size as the spacing unit then established for wells in the nearby field. However, in any instance where the well is projected to test a reservoir not then productive within two miles of the location, the AO shall be 160 acres if it is an oil or geothermal resources test and 640 acres if a gas test. However, only the surface use area delineated on the map attached to the plan of operations and approved by both the GS and BLM shall be for the exclusive use of the operator while such operations are being conducted thereon.

Should a well projected as an oil test be completed as a gas well, or vice versa, any additional surface use required by such completion will be subject to the pertinent approval procedures hereinafter set forth.

Regardless of the AO so established, the GS shall be solely reponsible for all oil, gas, or geothermal resources operations conducted thereon, including the enforcement of the surface protection and rehabilitation requirements, on approved surface use areas whereon such operations are normally conducted as follows:

a. Well sites - includes the area required for drilling and/or producing the well, normally 3 to 5 acres.

b. Tank batteries and treatment area - actual use areas as established by the approved plan of operations.

c. Gathering lines to and from the wells to the tank batteries or treatment facilities and access roads covered by the approved plan of operations.

For additional surface uses related to operations inside the AO but outside the production facilities or operations areas defined above, and not covered by an approved plan of operations, the operator shall submit his proposed plan of operations to the GS. The GS will not approve any such plan for additional surface uses until the requirements of Part D of this agreement have been satisfied. For surface uses within the AO other than those related to operations, the BLM shall be solely reponsible for authorizing such uses and the surface user (oil, gas, or geothermal resources operators,

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or other parties such as recreationists, special use permittees, etc.) shall submit their proposals directly to BLM who shall consult with GS to prevent or reduce any surface use conflicts. BLM will not approve any surface use within an AO which is contrary to GS recommendations without further discussions with GS. Any unresolved issues will be referred to appropriate Department officials for resolution.

All surface use requirements outside the limits of established Areas of Operations shall be the sole responsibility of the BLM.

A - PRELIMINARY FIELD INVESTIGATION (discretionary)

The Surface Disturbance Stipulations, which will be made a part of each oil and gas and geothermal resources lease, require that the operator, prior to his entry upon the land or the disturbance of the surface thereof for drilling or other purposes, shall furnish both the GS and the appropriate surface managing agency with a copy of a map and an explanation of the nature of the anticipated activity and surface disturbance. Maps furnished in this regard will not be accepted if on a scale less than one inch to the mile. Work such as surveying for a well site or access route is covered by this stipulation.

Upon receipt of the required map and the explanation of the proposed activity and if BLM is the surface managing agency, or where reserved minerals are involved, the GS will:

1. Contact both the operator and the BLM to schedule a coordinated joint field examination of the area if such inspection is deemed necessary by GS. In those instances where an inspection is considered unnecessary, the GS will not proceed further without first contacting BLM as to its need for a field inspection. If BLM desires such an inspection, GS will coordinate arrangements with the operator, participate in any such inspection, and furnish appropriate data. If neither bureau requires an inspection, no further action is necessary until such time as an application for permit to drill is filed with the GS. The time for such inspections will be scheduled as soon as possible, considering work priorities; however, the BLM will, in most instances, not be requested to set an inspection date that falls less than seven days from the date on which it is established that either one or both require an on-site

examination. In no event will the GS make a commitment to the operator as to when the inspection will be conducted until after BLM and GS have agreed upon a mutually acceptable date. This time may be reduced for high priority situations. The GS will encourage operators to file such maps and explanations at least 15 days in advance of the date on which they wish to enter upon the leasehold.

2. Confer with BLM and the operator to select the most feasible and environmentally acceptable areas for:

   a. Well sites (Geologic factors and both Federal and State regulations must be considered).

   b. Access routes.

   c. Any other proposed surface use.

3. Delineate on the maps supplied by the operator the AO which shall be established in accordance with the foregoing, the surface use activity areas within the AO which are directly related to the proposed operations, and the access route to the AO and the surface use areas which were tentatively approved by BLM, GS, and the operator in the joint field examination.

4. Encourage the operators to submit preliminary field development plans or drilling schedules to permit lead time for evaluating environmental considerations, resource conflicts, land use planning alternatives and revised plans prior to official submission. Furnish BLM such plans or schedules.

5. Take note of the resources which will be affected, the conflicts that may occur, and also the environmental impacts which are anticipated if the activity use takes place.

6. Furnish any information requested by BLM should BLM determine that it must prepare an environmental analysis record (EAR) as provided in item 7, page A-4.

7. Request BLM's surface protection and rehabilitation requirements for the contemplated surface use areas involved which will be made part of any subsequently approved plan of operations for such AO.

8. Prepare an Environmental Impact Statement (EIS) if the EAR prepared by the BLM, as provided for in item 7, page A-4, indicates that an EIS is necessary to comply with the requirements of Section 102(2)(c) of the National Environment Policy Act of 1969 (NEPA).

Upon receipt of the required map and the explanation of the proposed activity, the BLM will:

1. Review the Unit Resource Analysis and Management Framework plan for the Resource Area, noting existing or alternate access routes, existing and proposed resource uses in the area, what resources will be affected by the proposed use, known archaeological sites, etc.

2. Notify the GS in those instances where BLM determines that there is a need for a joint field inspection. However, in those instances where BLM considers an inspection to be unnecessary, it will participate in a joint inspection if GS desires such an examination and will, regardless of whether a joint on-site inspection is made, furnish GS with its surface protection and rehabilitation requirements.

3. Delineate on the maps furnished by the operator such items as existing or alternate access routes if not shown, and furnish the GS this information.

4. Confer with the GS and the operator to select the most feasible and environmentally acceptable areas for:

   a. Well sites (Geologic factors and both Federal and State regulations must be considered).

   b. Access routes.

   c. Any other proposed surface use.

5. Delineate on the maps supplied by the operator the AO which shall be established in accordance with the foregoing, the surface use activity areas within the AO which are directly related to the proposed operations, and the access route to the AO and the surface use areas which were tentatively approved by BLM, GS, and the operator in the joint field examination.

6. Take note of the resources which will be affected, the conflicts which may occur, and also the environmental impacts which are anticipated if the activity use takes place.

7. Where significant surface disturbance will occur as a result of surveying operations, prepare an environmental analysis record (EAR) with respect to such activity.

B - PROCESSING AND ISSUANCE OF A DRILLING PERMIT INVOLVING FEDERAL OIL AND GAS OR GEOTHERMAL RESOURCES LEASES

GS will:

1. Where BLM is the surface managing agency, or where reserved minerals are involved, send a copy of all applications for permits to drill exploratory and development wells, including the development plan and other appropriate information, to the proper BLM office immediately upon receipt of each such application (in high priority situations, the BLM will also be contacted verbally to expedite issuance of a drilling permit). Other appropriate data includes the "12-point plan" required by the GS but no subsurface data of a proprietary nature or other proprietary data or information will be furnished BLM; however, BLM can, upon request, inspect but not copy such data and information in the GS office.

    a. If the application is based on and follows closely the arrangements tentatively agreed upon at a preliminary joint field inspection as outlined in Section A, a second joint inspection will not be necessary.

    b. If the application deviates appreciably from the arrangements tentatively agreed upon at a preliminary joint field inspection as outlined in Section A, or if there has not been a preliminary joint field inspection, the procedure outlined in 2 and 3 below will be followed.

2. Contact the appropriate BLM office and the operator to establish a time and place to meet for a joint inspection of the drill site and access route for all exploratory well proposals and for development wells,

if such inspection is deemed necessary by GS. In those instances where an inspection is considered unnecessary, the GS will not proceed further without first contacting BLM as to its need for a field inspection. If BLM desires such an inspection, GS will coordinate arrangements with the operator, participate in any such inspection, and furnish appropriate data. Whether or not either bureau requires an on-site examination, BLM's surface protection and rehabilitation requirements will be requested and made a part of the approved plan of operations. The time for these inspections will be scheduled as soon as possible, considering work priorities; however, the BLM will, in most instances, not be requested to set an inspection date that falls less than seven days from the date on which it is established that either one or both require an on-site examination. In no event will the GS make a commitment to the operator as to when the inspection will be conducted until after BLM and GS have agreed upon a mutually acceptable date. This time may be reduced for high priority situations. The GS will encourage operators to file all applications at least 30 days in advance of the time they wish to enter upon the leasehold.

3. Schedule, insofar as possible, each inspection so that several future sites, access roads, etc., can be inspected at one time.

4. Prepare an environmental impact analysis (EIA)[1] utilizing BLM input for either 1(a) or 1(b) of this Part B on all exploratory wells and on those development wells which GS determines an EIA is required. Furnish BLM a copy of the EIA (the GS worksheet, Form 2-A, will not be furnished) or a statement of why one was not prepared for inclusion in BLM's official case file. All EIAs prepared in this regard will take into consideration the total aspects of the proposed operations including access to the AO and the proposed surface use areas within the AO.

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[1] Corresponds to BLM environmental analysis record (EAR).

Supply relevant data requested by BLM in those instances where it is determined that an EIA is not required but BLM finds it necessary to prepare an EAR to complete its records as provided in item 3, page B-5.

5. Prepare the EIS if the EIA indicates that one is necessary in order to comply with requirements of Section 102(2)(c) of the NEPA.

6. Delineate the AO and the approved surface use areas within the AO, including the access route to the AO and the surface use areas on the maps provided by the operator and make such map a part of the approved plan of operations. If a field examination is required, the delineation of the surface use areas shall not be made until after the field examination and mutual agreement is reached with BLM.

7. Where privately owned surface is involved in the surface use areas or access thereto, the operator will be required to furnish a copy of the contract or agreement with the private surface owner.

8. Supply the operator with the name, address, and both the home and office telephone numbers of the BLM contact who will be available for consultation during construction and rehabilitation activities.

9. Furnish BLM the name, address, and both the office and home telephone numbers of the GS Supervisor or the District Engineer to contact in case of emergencies or incidents of noncompliance with the surface use and rehabilitation requirements of the lease or approved plan of operations.

10. Furnish immediate notification of all approved drilling permits to the appropriate BLM office.

11. Require the operator to notify the GS of the exact day field operations will begin in areas where significant surface values, such as archaeological sites, require special protection. GS will immediately notify the BLM of such date.

12. Advise the operator that the GS will expect full compliance with the applicable laws, regulations, and the approved plan of operations, and further, that the GS will consider the operator to be fully responsible for the actions of his subcontractors.

13. Require all activities to be conducted so as to conform to the approved plan of operations and subsequent amendments made thereto by GS or requested by BLM. BLM may not directly amend any approved plan of operations but may suggest changes to GS which it believes should be incorporated as a result of circumstances not contemplated at the time the plan was first approved. The GS will not approve any plan of operations whic is inconsistent with BLM recommendations as to surface protection and rehabilitation requirements. Any unresolved disagreement with the original permit conditions or proposed amendments thereto will be referred to appropriate Departmental officials for resolution under procedures established by Section 2(a) of Secretarial Order No. 2948.

BLM will:

1. Upon receipt of the application for a drilling permit forwarded by the GS, notify the GS immediately in those instances where BLM determines that there is a need for a joint field inspection. However, in those instances where BLM considers an inspection to be unnecessary, it will participate in a joint inspection if GS desires such an examination and will, regardless of whether a joint inspection is made, furnish GS with its surface protection and rehabilitation requirements.

2. Provide GS with the name, address, and both the office and home telephone numbers of the BLM representative who will be available for consultation during construction and rehabilitation activities.

3. Furnish input data to GS for use in the preparation of an EIA. Where GS determines that an EIA is not required for a development well, BLM may individually, as it determines necessary, prepare an EAR to complete its records. BLM will furnish GS with a completed copy of its EAR.

4. Make a recommendation to the GS as to whether an environmental impact statement is needed.

5. Furnish the GS with a report, within ten working days following the joint inspection or within ten working days after receipt of the application for a permit to drill, if no joint inspection was deemed necessary by either bureau, setting forth the recommendations and requirements necessary to protect the surface resources and the rehabilitation requirements to be included in the drilling permit. The report shall confirm in writing and delineate on a map the AO, the surface use areas within the AO, and the access route to the AO and the surface use areas as agreed upon among BLM, GS, and the operator during their joint inspection or as a result of discussions, or both. For high priority situations the BLM representative may, with the concurrence of the District Manager, verbally inform the GS representative of the BLM requirements for the drilling permit. This verbal communication shall be followed up with a written report to the GS within 10 days thereafter.

6. At the request of GS, work directly with the operator in the rehabilitation of disturbed areas.

7. Contact Federal and State agencies and other operators in the area for information which will be helpful in implementing a successful rehabilitation program.

8. Make available to the GS and the operator any known or new rehabilitation procedures for the specific area of operation.

9. Provide GS with a written declaration prior to commencement of drilling operations, as to whether or not a water well is desired in case the well encounters a useable fresh water zone and is later abandoned. If at abandonment BLM elects to assume further responsibility for the well, it will reimburse the operator for any recoverable casing left in the hole solely because it is to be completed as a water well. The payment shall be based upon cost figures supplied by the operator prior to abandonment.

The operator will abandon the well to the base of the deepest fresh water zone of interest as required by the GS and will complete the surface clean-up operations as required by the drilling permit. BLM will accept liability for the well after GS has approved the abandonment and the surface clean-up operations have been completed to BLM's satisfaction. BLM will furnish GS with a written acceptance of all future responsibility for the well including its proper abandonment when it is no longer needed as a water well. In the event BLM requires a quitclaim deed from the operator, a copy thereof will be furnished to GS.

C - COMPLIANCE WITH TERMS AND CONDITIONS
EMERGENCY SITUATIONS

GS will:

1. Conduct inspections to insure that the operator is in compliance with terms and conditions of the lease and is conducting operations in accordance with the applicable regulations and the approved plan of operations.

2. Seek BLM assistance and expertise in surface management problems involving noncompliance with terms and conditions or stipulations, or for modifications requested by the operator.

3. Notify BLM of noncompliance which may require rehabilitation.

4. As appropriate, request the BLM to make inspections to assure compliance with the surface protection requirements of the approved plan of operations.

5. Seek all available help, including BLM, on major accidents or spills involving flowline or lease gathering facility spills, breaks in sludge pits, etc. Seek BLM expertise in rehabilitation and clean up operations.

BLM will:

1. Conduct inspections to insure compliance with the surface protection requirements of the lease and the approved plan of operations and will note operator noncompliance therewith. Except in an emergency, no instructions or directions will be given to the operator or his subcontractors without GS approval.

2. Notify GS immediately of all such incidents of noncompliance with the surface protection requirements of the lease or approved plan

3. Contact the operator directly only in cases involving an emergency such as accidental spills, flowline breaks, or other situations endangering health, safety, or significant resources.

GS will be immediately notified of any such actions taken by BLM. At that time GS will assume jurisdiction to expedite the necessary operations to resolve the emergency and will request BLM's assistance as needed in matters of surface clean up and rehabilitation.

4. If requested, furnish help during and after the emergency for clean up operations, and also furnish expertise for any required rehabilitation.

The agency responsible for seeking curative action on instances of non-compliance with the terms and conditions of the lease or the approved plan of operations will take the necessary action when notified of the non-compliance by the other agency.

D - MAINTENANCE OF FIELD ACTIVITIES INSIDE THE AREA OF OPERATION

GS will:

1. Require operators to file for approval a suitable plan with GS prior to undertaking any new construction, reconstruction or alteration of facilities, including roads, dams, reservoirs, etc., which will result in additional surface disturbance.

The operator must submit to GS enough information concerning the proposed activity to allow evaluation of possible surface disturbance.

2. Notify BLM of the proposed surface disturbing activity and furnish all available information.

3. Process the proposed plan only after receiving the input of BLM with respect to surface protection and rehabilitation requirements and make such requirements a part of the approved plan.

4. Make its approval of the plan subject to such conditions as shall be mutually agreeable to both the GS and BLM.

5. Make periodic inspections to assure that the operator is properly maintaining the facilities.

BLM will:

1. Respond timely to GS's notification that a plan has been filed for additional surface use within an AO by providing its recommended surface protection or rehabilitation requirements.

2. When requested by the GS, assist in resolving noncompliance with the terms and conditions or stipulations of any approved plan.

3. Make periodic inspections to assure that the operator is complying with the surface protection and rehabilitation requirements of the lease and the approved operating plan and will notify GS when it becomes aware of any operating condition warranting correction. The BLM, on its own initiative, may make recommendations to GS for the maintenance or rehabilitation of existing conditions adversely affecting the surface or other resources within an AO.

4. Notify GS of all applications which involve other surface uses of the lands within the AO for GS recommendations prior to approval of the application.

E - SURFACE USE MANAGEMENT OUTSIDE THE AREA OF OPERATION

BLM will:

1. Resolve surface use conflicts to the satisfaction of all users if possible; failing this, BLM will take appropriate steps to eliminate the conflict generally with priority consideration given to the continued mineral development. In that regard the comments and recommendations of the GS will be requested.

2. Work directly with all surface users in the area, including operators, regarding maintenance of roads and other support facilities, preventing damage to the surface resources, and encouraging public health and safety awareness.

3. Notify GS of all applications involving lands outside the AO where surface use may cause conflicts. Approval of applications will be based upon all considerations including recommendations from the GS.

GS will:

1. Contact BLM immediately if it becomes aware of any conflicts involving surface use.

2. Make recommendations to BLM if production facilities are being vandalized so protection measures, such as limiting or restricting public access into the area, may be initiated.

3. Make recommendations to both the operator and BLM to improve public health and safety conditions and other conditions such as road maintenance in the general area.

4. Work with BLM to resolve any surface use conflicts which may arise.

F - ABANDONMENT

GS will:

1. Notify BLM of cancellation or termination of any approved plan of operations under which no activity has taken place.

2. Send BLM a copy of all notices of intention to abandon. If the lease is to remain in effect, any proprietary data contained in a notice will be deleted. If that portion of the approved plan of operations covering surface rehabilitation does not contain information as to whether the well's casing is to be cut off below the ground surface or the abandonment marker is to be waived, or both, the BLM will be orally contacted for its recommendations.

3. Approve the surface and subsurface plugging program to be followed by the operator.

4. Not approve the abandonment of a well where BLM has furnished a written declaration of its interest in acquiring that well should it encounter useable fresh water, without first supplying BLM with the operator's estimated cost of the casing to be left in the hole and the opportunity to assume future responsibility for the well. GS will provide as much advance notice as is possible but it is recognized that in many instances it will be necessary that BLM's decision be made within a few hours after notification of the proposed abandonment.

5. As necessary, request that BLM work directly with the operator concerning surface rehabilitation.

6. Approve the subsequent report of abandonment only after a joint inspection by BLM and GS confirms that surface rehabilitation requirements of the approved plan of operations have been completed satisfactorily.

BLM will:

1. Upon being notified of the pending abandonment of a well which encountered useable fresh water and being furnished with the operator's estimated cost of the casing to be left in the hole, make a decision within the time allowed by GS as to whether it wants the well and will pay the attendant costs thereof (see item 9, page B-6).

2. Upon request, advise GS if the well's casing should be cut off below ground surface.

3. Upon request, advise the GS whether the required surface abandonment marker should be waived.

4. When requested by GS, work directly with the operator concerning surface rehabilitation.

5. Notify GS of any failure on the part of the operator to undertake surface rehabilitation measures which are required by the approved plan of operations.

6. Initiate action to have the operator's surety company perform the required rehabilitation if all efforts to secure the operator's compliance with the pertinent provisions of the approved plan of operations are unsuccessful.

7. Contact the surface owner where private lands are involved to ascertain acceptance of the surface rehabilitation. In no event shall the operator be required to perform less surface rehabilitation than that required by his prior contract or agreement with the private surface owner (see item 7, page B-3).

8. Notify GS of the operator's satisfactory completion of surface rehabilitation.

G - GENERAL

GS will:

Coordinate and communicate with lessees and operators and BLM concerning area development plans and other information requirements prior to submission of drilling applications.

BLM will:

If requested by GS, communicate with lessees and operators prior to submission of drilling applications to expedite BLM's input concerning surface management and rehabilitation requirements.

BLM and GS will:

1. Periodically hold joint meetings with lessees, operators, contractors, and other involved parties to discuss problems, stipulations working agreements, and other items of common concern.

2. Meet together periodically at the BLM State Office and GS Area Office level to discuss past and future procedures under these instructions. Where appropriate, the State Director and Area Supervisors may consummate regional cooperative agreements to supplement this agreement, subject to approval of such agreement by the Washington Offices of the GS and BLM.

3. Offer suggestions for revision of these procedures to their Washington Offices for improving their workability and to reduce duplication of effort in conducting these cooperative activities.

AUG 1 8 1975

Associate Director, Bureau of Land Management Date

8/25/75

Acting Director, Geological Survey Date

Form 3040–1
ovember 1970)
(formerly 3107–1)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

NOTICE OF INTENT TO CONDUCT OIL AND GAS EXPLORATION OPERATIONS

Name	Address *(include zip code)*

hereby files this "Notice of Intent to Conduct Oil and Gas Exploration Operations" across and upon *(give description of lands by township(s) and range)*

The type of operation to be pursued is ☐ magnetometer ☐ seismograph ☐ other *(specify)*

Approximate date of commencement of operations Upon completion of work, the Bureau of Land Management District Manager shall be furnished a "Notice of Completion of Oil and Gas Exploration Operations."

The undersigned agrees that oil and gas exploration operations will be conducted pursuant to the following terms and conditions:

1. Exploration operations shall be conducted in compliance with all Federal, State and County laws, ordinances or regulations which are applicable to the area of operations including, but not limited to, those pertaining to fire, sanitation, conservation, water pollution, fish and game. All operations hereunder shall be conducted in a prudent manner.
2. Due care will be exercised in protecting lands in this notice. All necessary precautions shall be taken to avoid any damage other than normal wear and tear, to gates, bridges, roads, culverts, cattle guards, fences, dams, dykes, vegetative cover and improvements, and stock watering and other facilities.
3. Appropriate procedures shall be taken to protect any shafts, pits or tunnels, and shot holes shall be capped when not in use to protect the lives, safety, or property of other persons or of wildlife and livestock.
4. All vehicles shall be operated at a reasonable rate of speed, and due care must be taken to safeguard all livestock and wildlife in the vicinity of his operations. Bulldozers shall not be used without advance notification to the District Manager. Existing roads and trails shall be used wherever possible; if new roads and trails are made, care should be taken to follow natural contours of the lands where feasible and restoration and/or reseeding, as requested by District Manager shall be made.
5. Upon expiration, revocation or abandonment of operations conducted pursuant to this "Notice," all equipment shall be removed from the land and the land shall be restored as nearly as practicable to its original condition by such measures as the District Manager may specify. All geophysical holes must be safely plugged. Upon leaving the land, the District Manager shall be informed.
6. Upon request, the location and depth of water sands encountered shall be disclosed to the District Manager.
7. The party conducting such operations shall contact the District Manager prior to actual entry upon the land in order to be apprised of the practices which should be followed or avoided in the conduct of his operations in order to minimize damages to property of the United States.

(Signature)

(Signature of Geophysical Operator)

(Address including zip code)

(Address including zip code)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

SURFACE DISTURBANCE STIPULATIONS

Area Oil and Gas Supervisor or District Engineer *(Address, include zip code)*

Management Agency *(name)*

Address *(include zip code)*

1. Notwithstanding any provision of this lease to the contrary, any drilling, construction, or other operation on the leased lands that will disturb the surface thereof or otherwise affect the environment, hereinafter called "surface disturbing operation," conducted by lessee shall be subject, as set forth in this stipulation, to prior approval of such operation by the Area Oil and Gas Supervisor in consultation with appropriate surface management agency and to such reasonable conditions, not inconsistent with the purposes for which this lease is issued, as the Supervisor may require to protect the surface of the leased lands and the environment.

2. Prior to entry upon the land or the disturbance of the surface thereof for drilling or other purposes, lessee shall submit for approval two (2) copies of a map and explanation of the nature of the anticipated activity and surface disturbance to the District Engineer or Area Oil and Gas Supervisor, as appropriate, and will also furnish the appropriate surface management agency named above, with a copy of such map and explanation.

An environmental analysis will be made by the Geological Survey in consultation with the appropriate surface management agency for the purpose of assuring proper protection of the surface, the natural resources, the environment, existing improvements, and for assuring timely reclamation of disturbed lands.

3. Upon completion of said environmental analysis, the District Engineer or Area Oil and Gas Supervisor, as appropriate, shall notify lessee of the conditions, if any, to which the proposed surface disturbing operations will be subject.

Said conditions may relate to any of the following:

(a) Location of drilling or other exploratory or developmental operations or the manner in which they are to be conducted;

(b) Types of vehicles that may be used and areas in which they may be used; and

(c) Manner or location in which improvements such as roads, buildings, pipelines, or other improvements are to be constructed.

Form 3109–5 (August 1973)

GPO 849-258

APPENDIX E

DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION

Notice to Lessees and Operators of Federal and Indian Onshore Oil and Gas Leases
(NTL-6)

APPROVAL OF OPERATIONS

In accordance with the National Environmental Policy Act of 1969 (83 Stat. 852), the United States Geological Survey must assure that operations on oil and gas leases under its jurisdiction are conducted with due regard for protection of the environment. All operations which are conducted on onshore Federal and Indian oil and gas leases must conform to the requirements of this Notice as well as those contained in the lease and in the Oil and Gas Operating Regulations, Title 30 CFR Part 221. Operations on Osage Indian oil and gas leases and exploration activities under Title 43 CFR 3045 are not included within the purview of this Notice.

As used in this Notice, the term "District Engineer" means that Officer of the United States Geological Survey who is the head of the District Office supervising operations in the geographic area in which the operation is located. In the State of Alaska, the Area Oil and Gas Supervisor will administer the requirements of this Notice. In some special instances, other Area Oil and Gas Supervisors will act on permit applications.

I. General

In order that the environmental impact of proposed operations may be properly evaluated, all applications to conduct leasehold operations or construction activities must be accompanied by an appropriate surface use plan. As a minimum, such applications and surface use plans must provide a detailed description of the technical aspects of the proposed operation or activity, the magnitude of surface disturbance involved, and the procedures to be followed in rehabilitating the surface once the operation or construction activity has been completed. Specific requirements in this regard are set forth in Sections II.B., III., and V. hereof. One copy of the surface use plan must be attached to each copy of the application to conduct operations or construction activities.

Applications to conduct operations or construction activities with attached surface use plans should be filed at least 30 days in advance of the contemplated starting date of any operation or construction activity in order to allow sufficient time in which to schedule and conduct, if necessary, a joint field inspection by appropriate personnel of the Geological Survey, the Federal surface management agency, the lessee or operator, and, if practical, the lessee's or operator's contractors and subcontractors who will perform the work. Any interested party who wishes may also attend the field inspection. The early filing of a complete application is no guarantee that approval thereof will be granted within the 30-day period, as environmental considerations or the volume of applications in the affected Federal agencies may result in more than 30-day delay.

All applications will be processed as quickly as possible in all Federal agencies consistent with other work in the offices. In general, the processing of applications will be assigned a high priority and individual applications will be processed according to the date the complete application is filed. A higher priority due to an emergency, such as an imminent lease expiration date, will be duly considered but no special consideration will be given simply because a late filing is made. If it is not possible for Geological Survey action to be taken prior to lease expiration or within 30 days of the filing date, whichever occurs first, the lessee or operator will be advised both orally and in writing. Said advice will detail the reasons for the delay so that the lessee or operator may take such appeal or other recourse as is allowed by law and/or regulation.

Lessees and operators have the responsibility to see that their exploration, development, production, and construction operations are conducted in a manner which (1) results in diligent development and efficient resource recovery; (2) affords adequate safeguards for the environment; (3) results in the proper rehabilitation of disturbed lands; (4) assures the protection of the public health and safety; and, (5) conforms with the best available practice. In that regard, lessees and operators will be held fully accountable for their contractors' and subcontractors' compliance with the requirements of the approved permit and surface use plan.

All approvals of proposed operations as well as subsequent instructions and regulation thereof will be by the District Engineer of the Geological Survey. However, the Federal surface management agency will establish the rehabilitation requirements and will be available for consultation during rehabilitation operations. Names, addresses, and phone numbers of appropriate personnel of the Geological Survey and the Federal surface management agency, as well as approved surface use areas, will be furnished the lessee or operator with its approved copy of the permit and surface use plan.

Lessees and operators, as well as their contractors and subcontractors, must not commence any operation or construction activity on a lease without the prior approval of the appropriate official of the Geological Survey. Said approvals may be oral in emergency situations or in instances such as subsurface plugging programs for newly-drilled dry holes or failures. Any oral approval so received must be followed by a written application and approval thereof for confirmation. Likewise, the terms and conditions of an approved permit and surface use plan may not be altered unless the Geological Survey has approved an amended or supplemental permit and/or plan covering any such modifications. Approval of subsequent operations is addressed in Section V. of this Notice.

II. Drilling Operations

A. Preliminary Environmental Review

A preliminary environmental review is required on all future drilling operations prior to entry on the ground for the purpose of staking the location, access roads, and other surface use areas. The lessee or operator, upon finalizing plans to drill but prior to the actual surveying, must file with the Geological Survey's District Engineer and the appropriate office of the involved Federal surface management agency, a topographic map, or such other map as is acceptable to the District Engineer, scale not less than 1 inch = 1 mile which shows the preferred location and the general topographic features in the area. This will permit the Federal suface management agency, prior to the lessee's or operator's expenditure of time and money for surveys, to review its records for any potential conflicts with other resource values. If conflicts are noted, a joint conference or field inspection, as appropriate, by the Geological Survey, the Federal surface management agency, the lessee or operator, and other interested parties may be scheduled to resolve problem areas. If the lessee or operator has not been advised to the contrary within 15 days from the date of submitting the preliminary map, it may assume that there are no objections to entry on the land for the purpose of required surveying and staking and may proceed accordingly. It is anticipated that the need for a joint field conference and/or inspection prior to staking will be very unusual.

B. Application for Permit to Drill

Drilling operations must not be conducted without a permit which has the prior approval of the District Engineer. Although multiple wells may be covered in a single surface use plan, the application for permit to drill must be submitted on an individual well basis.

The permit application filed for approval will consist of Form 9-331C (Application for Permit to Drill, Deepen, or Plug Back) and a multi-point surface use and operations plan. Where private surface is involved, it should also include a copy of the written agreement between the lessee or operator and the surface owner, a letter from the lessee or operator setting forth the rehabilitation requirements agreed to with said owner, or a letter stating the reasons why such agreement is not obtainable. The requirements for surface use and operations plans and the rehabilitation of private surface are contained in Sections III. and VI., respectively, of this Notice.

The application for permit to drill must provide information concerning (1) the location, as determined by a registered surveyor, in feet and direction from the nearest section lines of an established public land survey or, in areas where there are no public land surveys, by such other method as is acceptable to the District Engineer; (2) the elevation above sea level of the unprepared ground; (3) the geologic name of the surface formation; (4) the type of drilling tools and associated equipment to be utilized; (5) the proposed drilling depth; (6) the estimated tops of important geologic markers; (7) the estimated depths at which anticipated water, oil, gas, or other mineral bearing formations are expected to be encountered; (8) the proposed casing program including the size, grade, and weight of each string and whether it is new or used; (9) the proposed setting depth of each casing string and the amount and type of cement (including additives) to be used; (10) the lessee's or operator's minimum specifications for pressure control equipment which is to be used, a schematic diagram thereof showing sizes, pressure ratings (or API series), and the testing procedures and testing frequency; (11) the type and characteristics of the proposed circulating medium or mediums to be employed for rotary drilling and the quantities and types of mud and weighting material to be maintained; (12) the testing, logging, and coring programs to be followed with provision made for required flexibility; (13) any anticipated abnormal pressures or temperatures expected to be encountered or potential hazards such as hydrogen sulfide gas, along with plans for mitigating such hazards; (14) the anticipated starting date and duration of the operation; and, (15) any other facets of the proposed operation which the lessee or operator wishes to point out for the Geological Survey's consideration of the application. The District Engineer will require additional information as warranted.

A copy of the approved application for permit to drill and the accompanying surface use and operations plan along with any conditions of approval shall be available to authorized personnel at the drillsite whenever active construction or drilling operations are underway.

III. Multi-Point Surface Use and Operations Plan

A surface use and operations plan in sufficient detail to permit a complete appraisal of the environmental effects associated with the proposed project must be submitted, in triplicate, to the District Engineer with the application for permit to drill.

The Geological Survey will send a copy of such plan to the Federal surface management agency. When possible, a preliminary field development plan or drilling schedule concerning the lessee's or operator's plans for additional development should also be submitted to allow lead time for evaluating environmental considerations, resource conflicts, and land use planning alternatives.

The surface use and operations plan shall, in its context, provide for adequate protection of surface resources, other environmental components, and include adequate measures for rehabilitation of disturbed lands. The plan shall be developed in conformity with the provisions of the lease, attached stipulations, and the guidelines provided by this Notice. In developing the plan, the lessee or operator will make use of such information as is available from the Federal surface management agency concerning the surface resources, environmental considerations, and local rehabilitation procedures. The plan will be reviewed for adequacy by the Geological Survey and the Federal surface management agency. The Geological Survey will act as the lead agency in assessing the effects of the plan. If the plan is considered inadequate, the Geological Survey will, in consultation with the Federal surface management agency, require modification or amendment of the plan or otherwise set forth such stipulations or conditions of approval as are necessary for the protection of surface resources and environment, including rehabilitation of the disturbed areas.

A. Guidelines for the preparation of surface use and operations plan

In the preparation of surface use and operations plans, lessees and operators should submit maps, facility layouts and narrative descriptions which adhere closely to the following:

1. Existing roads. A legible map (USGS topographic, county road map, or such other map as is acceptable to the District Engineer and the Federal surface management agency) shall be used for locating the proposed well site in relation to a town or other locatable reference point. The proposed route to the location including appropriate distances from the reference point to the point where the access route exits the highway or county road shall be shown. All proposed access roads shall be appropriately labeled or color coded. Additionally, all existing roads within a radius of three miles (including information relative to the type of surface, condition, and load capacity) from the location of a proposed exploratory well should be shown. For the purpose of this Notice, an exploratory well is defined as a well which is located two miles or more from the boundary of a Known Geologic Structure (as such term is defined by USGS) or a producible well. For all other drillsites (development wells), existing roads within a one-mile radius of the location should be shown.

   Any plans for the improvement and/or maintenance of existing roads should also be stated.

   Information required by item Nos. 2, 3, 4, 5, 6, 7, and 9 of this subsection may also be shown on this map if appropriately labeled.

2. Planned access roads. Information in this regard is to be submitted on a map of suitable scale and shall appropriately identify all permanent and temporary access roads that are to be constructed, or reconstructed in connection with the drilling and production of the proposed well. Width,

maximum grade, turnouts, drainage design, location and size of culverts, and surfacing material, if any, shall be stated. At the time of submittal, the center line location of all proposed new or reconstructed roads shall be staked with the stakes being visible from any one to the next. However, modification of proposed road design may be required after the location is accepted for drilling. If the well is completed for production, final road design and construction will depend on the amount and type of hydrocarbon found by the well. Information should also be furnished to indicate where existing fences will be cut and whether gates or cattleguards will be used. Additionally, the discussion should make reference to any existing gates which are to be replaced by cattleguards. Cattleguards which are installed or replaced must be designed to adequately carry anticipated loads.

3. Location of existing wells. This information should be submitted on a map of suitable scale and include all wells (water, abandoned, temporarily abandoned, disposal, and drilling) within a two-mile radius of the proposed location of an exploratory well and all wells (water, producing, abandoned, temporarily abandoned, shut-in, injection, disposal, and drilling) within a one-mile radius of the proposed location of a development well.

4. Location of tank batteries, production facilities, and production, gathering, and service lines. Existing tank batteries, production facilities, and production, gathering, or service lines within a one-mile radius of the proposed location which are owned or controlled by the lessee or operator should be shown on a map or plat of suitable scale. The type of each present facility and the exact nature of each existing line (oil flow line, gas gathering line, injection line, or water disposal line) should be identified and it should be noted which, if any, of said lines are buried. If new facilities (tank battery, other production equipment, and lines) are contemplated in the event production is

established and those facilities are to be located at other than on the well site itself, the map or plat furnished in this regard must also indicate the location of all proposed new facilities. The dimensions of these facilities, the proposed construction methods and materials, and the protective measures and devices to be employed to minimize hazards to livestock, waterfowl, and other wildlife will be stated. The approximate center locations of all production facility locations and the center lines of proposed gathering and service lines will be staked. A plan for rehabilitation of all disturbed areas no longer needed for operations and maintenance will also be submitted. Future prospects for additional development of the leasehold should be considered in the siting of new facilities. However, final approval to construct such new facilities will not be granted until after detailed plans have been submitted and evaluated pursuant to Section V. hereof.

5. Location and type of water supply (rivers, creeks, lakes, ponds, and wells). This information may be shown by quarter-quarter section on a plat or map of suitable scale or may be a written description. The source of all water to be used in drilling the proposed well must be noted if located on Federal or Indian land or if water is to be used from a Federal or Indian project. The method of transporting the water shall be stated, and any access roads crossing Federal or Indian land needed to haul the water will be described in item Nos. 1 or 2, as appropriate. However, the Survey's approval of the surface use and operations plan does not relieve the lessee or operator from obtaining any other authorization which may be required for the use of such water. Moreover, if a water supply well is to be drilled on the lease, it must be so stated under this item, and the District Engineer may require the filing of a separate application for permit to drill.

6. Source of construction materials. This information may be shown by quarter-quarter section on a plat or map of suitable scale or may be a written description. The proposed source (if located on Federal or Indian land), character, and use of all construction materials such as sand, gravel, stone, and soil material should be stated. Any access roads crossing Federal or Indian land needed to haul such materials should be described in item Nos. 1 or 2, as appropriate.

7. Methods for handling waste disposal. A brief, written description should be given of the methods and location proposed for safe containment and disposal of each type of waste material (cuttings, garbage, salts, chemicals, and sewage) which results from the drilling of the proposed well. Likewise, the narrative should include plans for the eventual disposal of drilling fluids and any produced oil or water recovered during testing operations.

8. Ancillary facilities. The plans or subsequent amendments to such plans shall identify all ancillary facilities such as camps and airstrips as to their location, land area required, and the methods and standards to be employed in their construction. Such facilities shall be shown on a map of suitable scale. The approximate center of proposed camps and the center line of airstrips shall be staked on the ground.

9. Well site layout. A plat of suitable scale (not less than 1 inch = 50 feet) including cross section diagrams of the drill pad showing all cuts and fills and the relation to topography are required. The plat should also include the proposed location of the mud tanks, pits (reserve, burn, and trash), pipe racks, access roads, turnaround areas, parking areas, living facilities, soil material stockpiles, and the orientation of the rig with respect to the pad and other faciities. Plans, if any, to line the reserve pit should be indicated.

   Until such time as the location is approved, it will be necessary to stake only the actual location of the well.

After approval and before construction commences, the exterior dimensions of the pad and reserve pit will be staked on the ground. The stakes should be appropriately marked to indicate proper cuts and fills to the dirt contractor.

10. Plans for restoration of the surface. State the proposed program for surface restoration upon completion of the operation such as determination of the reshaped topography, drainage system, segregation of spoils materials, surface manipulations, waste disposal, revegetation methods, soil treatments, and amendments, plus other practices necessary to rehabilitate all disturbed areas including any access roads no longer needed. Such plans will be reviewed for adequacy by the appropriate Federal surface management agency. A proposed timetable for the commencement and completion of rehabilitation operations must be provided.

11. Other information. Include a general description of the topography, soil characteristics, formation lithologies, geologic features, flora, fauna, and other aspects of the area such as other surface use activities. The surface ownership (Federal, Indian, State, or private) at the well location and for all lands which are to be crossed by newly constructed or upgraded roads should be indicated.

    Any other available information which is considered by the lessee or operator as being useful to the Geological Survey and Federal surface managing agency in evaluating the environmental impact of the proposed operation, including proximity to steep hillsides and gullies, water wells, ponds, lakes, or streams, occupied dwellings, or other facilities, and archeological, historical, or cultural sites, should be included.

    Information concerning required cuts and fills during the construction of roads and the location and all construction practices necessary to accommodate potential geologic hazards should be discussed under the appropriate items of the plan.

12. Lessee's or operator's representative. Include the name, address, and phone number of the lessee's or operator's field representative who is responsible for assuring compliance with the approved surface use and operations plan.

13. Certification. The following statement is to be incorporated in the plan and must be signed by the lessee's or operator's field representative who is identified in item No. 12 of the plan:

> I hereby certify that I, or persons under my direct supervision, have inspected the proposed drillsite and access route; that I am familiar with the conditions which presently exist; that the statements made in this plan are, to the best of my knowledge, true and correct; and, that the work associated with the operations proposed herein will be performed by ______________________ ____________ and its contractors and subcontractors in conformity with this plan and the terms and conditions under which it is approved.

______________ ______________________

Date Name and Title

IV. Environmental Analysis Requirements

If a preliminary inspection was not made prior to staking, an onsite inspection will normally be required following the filing of the application for permit to drill. If made, it will include representatives of the District Engineer, the lessee or operator, the Federal surface management agency, and such other interested parties as the lessee's or operator's dirt contractor. The purpose of this inspection will be to select the most feasible and environmentally acceptable areas for well sites (considering geologic factors and Federal and State regulations), access roads, and other proposed surface use areas. Accordingly, lessees and operators are encouraged to designate their future development or drilling sites so that several locations may be inspected at one time.

When such an inspection is made, an Environmental Analysis will usually be prepared by the office of the District Engineer. Said analysis will identify methods for mitigating the potential adverse environmental effects associated with the proposed operation and will be the basis of the approving official's determination as to whether approval of the proposed activity would constitute a major Federal action significantly affecting the quality of the human environment as defined by Section 102(2)(C) of the National Environmental Policy Act of 1969. Any surface protection and rehabilitation requirements specified by the Federal surface management agency will normally be made a part of any subsequently approved permit and/or the surface use and operations plan.

Due to the probability of an onsite inspection, the required input from other Federal agencies, and the variations in the level of drilling activity, lessees and operators are encouraged to file applications well in advance of the time when it is desired to commence operations.

V. Approval of Subsequent Operations

Before repairing, deepening, or conditioning a well, i.e., work that will involve change in the original or plugged back depth, casing arrangement, and/or present producing interval(s) including separation or commingling, a detailed written statement of the plan of work must be filed on Form 9-331A or 9-331C with the District Engineer and approval obtained before the work is started. Any proposed change in any such plan of work must also receive the prior approval of the District Engineer. Routine well work such as pump, rods, tubing and surface production equipment repairs will not require submittal of Form 9-331A unless specifically required by the District Engineer.

Lessees and operators are also required to submit for the approval of the District Engineer a suitable plan prior to undertaking any subsequent new construction, reconstruction, or alteration of existing facilities, including roads, dams, lines or other production facilities on any lease when additional surface disturbance will result. However, emergency repairs may be conducted without prior approval provided that prompt notification is provided to the District Engineer. Sufficient information must be submitted to permit a proper evaluation of the proposed surface disturbing activities as well as any planned accommodations necessary to mitigate potential adverse environmental effects.

The environmental analysis procedures discussed in Section IV. of this Notice will also apply to such subsequent operations which have the potential for significant surface disturbance although these requirements may be somewhat less in established producing areas.

VI. Agreement for Rehabilitation of Privately-Owned Surface

Where the surface is privately owned or is held in trust for Indian benefit, each application for permit to drill or to conduct other surface disturbance activities, shall contain information concerning the private surface owner's or Indian rehabilitation requirements. A written agreement between the lessee or operator and the surface owner is not necessary if a letter from the lessee or the operator setting forth the surface owner's rehabilitation requirements is furnished. In those cases where it is impossible or impractical to obtain the private surface owner's or Indian rehabilitation requirements, a letter from the lessee or operator describing the situation will be acceptable. Payment of damages in lieu of full restoration will not be an acceptable substitute for a normal cleanup and rehabilitation program.

If no arrangements have been made, or if information concerning such arrangements is not furnished, the District Engineer will request the appropriate Federal agency to recommend the necessary surface restoration requirements. In such cases, the lessee or operator will be expected to comply with these rehabilitation requirements, if any, regardless of the arrangement made with the surface owner. Provided, however, that subsequent reasonable requests by the surface owner that pits, roads, and other facilities be left intact may be honored. If written proof of prior arrangements has been provided, the appropriate Federal agency will be asked to recommend surface rehabilitation requirements to the District Engineer giving full consideration to the preferences of the landowner.

VII. Well Abandonment

No well abandonment operations may be commenced in the absence of the prior approval of the District Engineer. In the case of newly drilled dry holes or failures and in emergency situations, oral approval may be obtained from the District Engineer subject to confirmation by written application. For existing wells not having an approved surface use plan, a sketch showing the disturbed area and roads to be abandoned along with rehabilitation plans must be submitted with the application. However, the Federal surface management agency may request additional surface rehabilitation measures at abandonment and, these requirements are normally made a part of the Geological Survey's approval of abandonment. Upon completion of the abandonment and rehabilitation operations, the lessee or operator should notify the District Engineer that the location is ready for inspection usually via an additional Sundry Notice. Final abandonment will not be approved until the surface rehabilitation work required by the drilling permit or abandonment notice has been completed and the required vegetation is established to the satisfaction of the appropriate Federal surface management agency.

VIII. Water Well Conversion

The complete abandonment of a well which has encountered usable fresh water will not be approved if the Federal surface management agency wants to acquire the well. If, at abandonment, the Federal surface management agency elects to assume further responsibility for the well, it will reimburse the lessee or operator for the cost of any recoverable casing or well head equipment which it requests to be left in or on the hole solely because it is to be completed as a water well. The lessee or operator will abandon the well to the base of the deepest fresh water zone of interest as required by the District Engineer and will complete the surface cleanup and rehabilitation as required by the drilling permit or abandonment notice immediately upon completion of the conversion operations.

JUN 1 1976
Date

F. J. Schambeck
Oil and Gas Supervisor

Pacific Area

Approved:

Russell G. Wayland
Russell G. Wayland
Chief, Conservation Division

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION

Notice to Lessees and Operators of Federal and Indian Oil and Gas Leases

(NTL-2B)

Disposal of Produced Water

This Notice supersedes NTL-2 and 2A and is issued pursuant to the authority prescribed in 30 CFR 221.4 and 221.32. Lessees and operators of onshore Federal and Indian oil and gas leases or fee and State leases committed to federally supervised unitized or communitized areas shall comply with the following requirements for the handling, storing, or disposing of water produced from oil and gas wells on such leases.

As used in this Notice, the term "District Engineer" means the District Engineer, U.S. Geological Survey. However, in the State of Alaska, the requirements of this Notice will be administered by the Area Oil and Gas Supervisor.

I DISPOSAL REQUIREMENTS AND APPLICATIONS FOR APPROVAL OF DISPOSAL METHODS

By October 1, 1977, all produced water from the above said leases must be disposed of by (1) injection into the subsurface; (2) lined pits; or, (3) by other acceptable methods. All such disposal methods must be approved in writing by the District Engineer regardless of the physical location of the disposal facility. Any method of disposal which has not been approved as of October 1, 1977, will be considered as an incident of noncompliance and will be grounds for issuing a shut-in order until an acceptable manner for disposing of said water is provided and approved by the District Engineer. Lessees and operators are encouraged to file applications in this regard as promptly as possible and are forewarned that applications for approval of existing disposal facilities which are filed after July 1, 1977, may not be timely approved.

No additional approval is required for facilities previously approved by the Geological Survey which involve the disposal of produced water into the subsurface or in lined surface pits. Likewise, no further approval is necessary for existing injection facilities utilized for pressure maintenance or secondary recovery operations.

Lessees and operators who are presently disposing of water in unlined surface pits must timely file applications with the District Engineer for approval of present or proposed disposal methods. Likewise, lessees and operators who are presently disposing of produced water in the subsurface or in lined surface pits without approval of the Geological Survey must also file applications for approval thereof by the District Engineer.

The District Engineer may require modification of any disposal facility prior to October 1, 1977, whenever it is determined that continued use of such facility is endangering the fresh water in the area or is otherwise adversely affecting the environment.

Any application to dispose of produced water must specify the proposed method of disposal and provide the information necessary to justify the method. Required information which must be included in applications for approval of produced water disposal in the subsurface, in lined pits, or in unlined pits is set forth in Sections II, III, and IV, respectively, of this Notice. Additional information may be required by the District Engineer in individual cases. Previous applications filed in response to NTL-2 and NTL-2A which do not meet the data requirements of this Notice must be supplemented or resubmitted.

A single application may be submitted for several leases or facilities provided that (1) the leases or facilities are located in the same field; (2) the produced water is from the same formation or is of similar quality; (3) the volume and source of the water is shown separately for each disposal facility; and, (4) the method of disposal is the same in every case.

II DISPOSAL IN THE SUBSURFACE

If approval is requested for subsurface water injection in connection with secondary recovery operations or for disposal purposes, the lessee or operator must furnish information which includes:

1. The designated name and number of the proposed disposal well and its location in feet and direction from the nearest section lines of an established survey. The applicable Federal or Indian oil and gas lease number or other permit and/or the ownership of the surface and minerals if other than Federal or Indian.

2. The daily quantity and sources of the produced water and a water analysis which includes total dissolved solids, pH, and the concentrations of chlorides and sulfates.

3. The injection formation and interval.

4. The quality of the fluids in the injection interval, i.e., total dissolved solids.

5. The depth and areal extent of all usable water (i.e., less than 10,000 ppm total dissolved solids) aquifers in the area.

6. The size, weight, grade and casing points of all casing strings, the size hole drilled to accommodate each string, the amount and type of cement, including additives used in cementing each string, and the top of the cement behind each casing string. In addition, bond logs may be required in certain instances.

7. The total and plugged back depth of the well.

8. The present or proposed method of completing the well for injection including the type and size of tubing and packer to be utilized, the setting depth of the packer, anticipated injection pressure, and information concerning any corrosion inhibitor fluid which is to be placed in the tubing-casing annulus.

9. Plans for monitoring the system to assure that injection is confined to the injection interval and measures to be taken should it be necessary to shut-in the disposal system.

In order to be approved, subsurface disposal must be confined (1) to formations which contain water of similar or poorer quality than the injected water or (2) to formations that contain water of such poor quality as to eliminate any practical use thereof.

In general, it will be required that subsurface disposal be accomplished through tubing utilizing a packer which is designed to hold pressure from above and below. The packer should be set at a depth where the casing is protected by competent cement but normally not more than 50 feet above the injection interval. Other procedures or methods of subsurface disposal may be approved by the District Engineer when justified by the lessee or operator.

III DISPOSAL IN LINED PITS

Where approval is requested for surface disposal in a lined pit, the lessee or operator must supply information which includes:

1. A topographic map of suitable scale which shows the size and location of pit.
2. The daily quantity, sources of the produced water, and a water analysis which includes the concentrations of chlorides, sulfates, and other constituents which are toxic to animal, plant, or aquatic life.
3. The evaporation rate for the area compensated for annual rainfall.
4. The method for periodic disposal of precipitated solids.
5. The type of material to be used for lining the pit and the method of installation.
6. The method to be employed for the detection of leaks and plans for corrective action should a leak occur in the liner.

The material used in lining pits must be impervious, weather-resistant, and not subject to deterioration when contacted by hydrocarbons, aqueous acids, alkalies, fungi, or other substances likely to be contained in the produced water. Lined pits constructed after the issuance of this Notice must have an underlying gravel-filled sump and lateral system or other suitable devices for the detection of leaks. The District Engineer shall be provided an opportunity to inspect the leak detection system prior to the installation of the pit liner.

IV DISPOSAL IN UNLINED PITS

Surface disposal into unlined pits will not be considered for approval by the District Engineer unless the lessee or operator can show by application that such disposal meets any one or more of the following criteria:

Where beneficial use is the basis for the application, the justification submitted must contain written confirmation from the user(s) and the water analysis must also include the oil and grease content, temperature, and the concentration of other constituents which are toxic to animal, plant, or aquatic life.

If the application is made on the basis that surface and subsurface fresh waters will not be affected by disposal in an unlined pit, the justification must also include:

1. Analyses of all surface and subsurface waters in the area which might reasonably be affected by the proposed disposal.
2. Maps or plats showing the location of surface waters, fresh water wells, and existing water disposal facilities within two miles of the proposed disposal facility.
3. Reasonable geologic and hydrologic evidence showing that the proposed disposal method will not adversely impact on existing water quality or major uses of such waters; the depth of the shallowest fresh water aquifer in the area and the presence of any impermeable barrier(s).
4. A copy of any State order or other authorization granted as a result of a public hearing which is pertinent to the District Engineer's consideration of the application.

If the application is for disposal pursuant to an NPDES permit, only a topographic map showing the size and location of the pit together with a copy of the approved permit and the most recent "Discharge Monitoring Report" will be required.

V GENERAL REQUIREMENTS FOR PERMANENT SURFACE PITS

Lined and unlined pits approved for water disposal shall:

1. Have adequate storage capacity to safely contain all produced water even in those months when evaporation rates are at a minimum.
2. Be constructed, maintained, and operated to prevent unauthorized surface discharges of water. Unless surface discharge is authorized, no siphon, except between pits, will be permitted.

1. The water to be disposed of has an annual weighted average concentration of not more than 5,000 ppm of total dissolved solids, provided that such water does not contain objectionable levels of any constituent toxic to animal, plant, or aquatic life.

2. That all, or a substantial part, of the produced water is being used for beneficial purposes. For example, produced water used for purposes such as irrigation and livestock or wildlife watering shall be considered as being beneficially used.

3. The water to be disposed of is not of poorer quality than the surface or subsurface waters in the area which reasonably might be affected by such disposal or the surface and subsurface waters are of such poor quality as to eliminate any practical use thereof.

4. The volume of water to be disposed of per facility does not exceed five barrels per day on a monthly basis.

5. The specific method of disposal has been granted a surface discharge permit under the National Pollutant Discharge Elimination System (NPDES).

Applications for approval of unlined surface pits pursuant to exception Nos. 1, 2, 3, or 4, above, must include:

1. The daily quantity and sources of the produced water and for exception Nos. 1 through 3, a water analysis which includes total dissolved solids, pH, and the concentrations of chlorides and sulfates.

2. A topographic map of suitable scale which shows the size and location of the pit.

3. The evaporation rate for the area compensated for annual rainfall.

4. The estimated percolation rate based on the soil characteristics under and adjacent to the pit.

5. The depth and areal extent of all usable water (i.e., less than 10,000 ppm total dissolved solids) aquifers in the area.

3. Be fenced to prevent livestock or wildlife entry to the pit, when required by the District Engineer.

4. Be kept reasonably free from surface accumulations of liquid hydrocarbons by use of approved skimmer pits, settling tanks, or other suitable equipment.

5. Be located away from the established drainage patterns in the area and be constructed so as to prevent the entrance of surface water.

VI TEMPORARY USE OF SURFACE PITS

Unlined surface pits may be used for handling or storage of fluids used in drilling, redrilling, reworking, deepening, or plugging of a well provided that such facilities are promptly and properly emptied and restored upon completion of the operations. Mud or other fluids contained in such pits shall not be disposed of by cutting the pit walls without the prior authorization of the District Engineer. Until finally restored, unattended pits must be fenced to prevent access by livestock and wildlife. Unless otherwise specified by the District Engineer, unlined pits may be used for well evaluation purposes for a period of 30 days.

Unlined pits may also be retained as temporary containment pits for use only in an emergency provided such pits have been approved by the District Engineer. Any emergency use of such pits shall be reported to the District Engineer as soon as possible and the pit shall be emptied and the liquids disposed of in an approved manner within 48 hours following its use, unless such time is extended by the District Engineer.

VII DISPOSAL FACILITIES FOR NEW WELLS

With the approval of the District Engineer, produced water from wells completed after the issuance date of this Notice may be temporarily disposed of into unlined pits for a period up to 90 days. During the period so authorized, an application for approval of the permanent disposal method, along with the required water analysis and other information, must be submitted to the District Engineer. Failure to timely file an application within the time allowed will be considered an incident of noncompliance and will be grounds for issuing a shut-in order until the application is submitted. With the approval of the District Engineer, the disposal method may be continued pending his final determination. Once the District Engineer has determined the proper method of disposal, the lessee or operator will have until October 1, 1977, or 60 days following receipt of the District Engineer's determination, whichever is the longer, in which to make any changes necessary to bring the disposal method into compliance. However, if the disposal method then employed is endangering the fresh water in the area or otherwise constitutes a hazard to the quality of the environment, the District Engineer will direct prompt compliance with the requirements of this Notice.

VIII UNAVOIDABLE DELAY

A single extension of time not to exceed three months (six months in arctic and subarctic areas) may be granted by the District Engineer where the lessee or operator conclusively shows by application that, despite the exercise of due care and diligence, he has been unable to timely comply with the requirements of the Notice provided that such delay will not adversely affect the environment.

IX REPORTS

All unauthorized discharges or spills from disposal facilities must be reported to the District Engineer in accordance with the provisions of NTL-3.

Beginning October 1, 1978, and thereafter on an annual basis, lessees and operators must submit a report for each facility which includes the total volume disposed of during the reporting period and a current water analysis which provides the same type of information required for approval of the original application. Provided, however, that:

1. Where disposal is approved pursuant to Section IV (4), no annual water analysis will be required.

2. Where disposal is approved pursuant to a NPDES permit, a copy of the required discharge monitoring report may be submitted in lieu of the above annual report.

3. Where a single application was approved for several leases and/or facilities, a composite annual report covering all such leases and facilities may be submitted.

X COMPLIANCE

Compliance with this Notice does not relieve a lessee or operator of the responsibility for complying with more stringent applicable Federal or State water quality laws and regulations, including those which are subsequently promulgated pursuant to the Safe Drinking Water Act (P.L. 92-523), or with other written orders of the Geological Survey.

JAN 1 1976
Date

F. J. Schambeck
Area Oil and Gas Supervisor

APPROVED:

Russell G. Wayland
Russell G. Wayland
Chief, Conservation Division

DRILLING MUD MATERIALS

FUNCTION	MATERIALS	WHY USED
Lubricants	Certain oils, graphite powder and soaps.	To reduce down-hole friction.
Flocculants	Salt, Hydrated lime, Gypsum and Sodium Tetraphosphates.	To increase gel strength. Causes some solids to settle out.
Filtrate Reducers	Bentonite clays, Sodium carboxy-methyl celluiose (CMC) and pregelatinized starch.	Reduce filter loss. Prevent "water loss" to porous formations
Foaming Agents	Anionic foaming chemicals.	Causes formation water to foam helping gas or air drilling to continue.
Lost Circulation	Asphalt Emulsions, Asbestos Fibers, Shredded Plastics, Mica Flakes, Nut Hulls, Cedar Fibers, Cottonseed Hulls and many other materials.	To stop mud loss to porous zones.
Shale Control Inhibitors	Gypsum, Sodium Silicate, Chrome Lignosulfates, Lime and salt.	To stop or prevent swelling of shales or clays.
Surface Active Agents	Surfactant Chemicals	To permit better mixing. Example- water and oil.
Thinners and Dispersants	Quebracho, some Polyphosphates and lignitic materials.	To prevent too high a viscosity, improve pumpability, better solids distribution in muds.
Viscosifiers	Bentonite, CMC, Attapulgite clays and Asbestos Fibers.	To increase fiscosity for cuttings removal and gel strength.
Preservatives	Formaldehyde	Prevent starch mud from fermenting.

DRILLING AND MATERIALS (Cont.)

FUNCTION	MATERIALS	WHY USED
Cement Contamination	Sodium Bicarbonate	Prevents mud destruction.
Calcium Removers	Caustic Soda, Soda Ash, Certain Polyphosphates (SAPP) and Sodium Bicarbonate.	To prevent mud destruction by Gypsum or Anhydrite.
Weight Materials	Barite, Lead Compounds, Iron Oxides and high specific gravity compounds.	To increase mud weight (pounds per gallon) to hold formation fluids in place and prevent hole caving.
Corrosion Inhibitors	Hydrated Lime, Amine Salts and Dichromate salts.	To prevent corrosion of drilling equipment and casing.
Oil Emulsion	Special Emulsifiers or Soaps.	To make oil-in-water or water-in-oil emulsions for "oil base" mud.

Sources:

American Association of Oilwell Drilling Contractors. Toolpusher's Manual, Section O. September 1970.

Gatlin, Carl. Petroleum Engineering, "Drilling and Well Completions," Chapter 6. Prentice-Hall, Inc. New York. 1960.

MODELS OF SURFACE USE REQUIREMENTS OF OIL PRODUCTION ON 20-ACRE TO 640-ACRE PER WELL SPACING PATTERNS

The models show land required for roads, well sites, flowlines, tank batteries and waste water disposal facilities for leases containing 10 producing wells.

20-, 40- and 80-Acre Per Well Spacing Patterns

Figure I-C-1 shows a possible road, flowline, tank battery and water disposal layout for a 960-acre lease with 10 producing wells established on an 80-acre per well spacing pattern (Model "C"). One of the dry or depleted holes is used for waste water injection. The layouts of Models "A" and "B" are similar in concept. Three combinations of well spacing patterns and lease sizes are included.

D = Acres used during development phase
P = Acres used during production phase

	Model A	Model B	Model C
Acres in lease	240	480	960
Acres per well (well spacing)	20	40	80
Number of producing wells	10	10	10
Number of dry holes	2	2	2
Number of disposal wells (converted dry holes)	1	1	1

Land Requirements

	Model A		Model B		Model C	
	D	P	D	P	D	P
1. Acres Per Well						
a. Roads	0.28	0.55	0.33	0.65	0.50	1.00
b. Well sites	.75	0.01	1.00	0.01	1.00	0.01
c. Flowlines	0.25	0	0.30	0	0.50	0
Total Per Well	1.28	0.56	1.63	0.66	2.00	1.01
2. Acres Per Lease						
a. Tank battery	0	0.35	0	0.35	0	0.35
b. Office and storage	0	1.00	0	1.00	0	1.00
c. Water-yard-disposal	0	0.50	0	0.50	0	0.50
Total Per Lease	0	1.85	0	1.85	0	1.85

	Model A		Model B		Model C	
	D	P	D	P	D	P
3. Total Acres						
a. Well acres	12.80	5.60	16.30	6.60	20.00	10.10
b. Dry holes-disposal well	2.06	0.56	2.66	0.66	3.00	1.01
c. Other lease areas	0	1.85	0	1.85	0	1.85
Total Acres	14.86	8.01	18.96	9.11	23.00	12.96
4. Percent of Lease Area Used	6.2	3.3	3.9	1.9	2.4	1.4
5. Acres Used Per Well	1.2	0.7	1.6	0.8	1.9	1.2
6. Acres Used Per Sq. Mile	38.4	22.4	25.6	12.8	15.2	9.6

160-, 320- and 640-Acre Per Well Spacing Patterns

Well spacing patterns for deep-well fields may range from 160 to 640 acres per well. Figure I-C-2 shows well locations commonly used for 160-, 320-, and 640-acre per well spacing patterns. Figure I-C-3 shows a possible well, road, flowline and storage tank layout for a 160-acre per well spacing pattern.

	Model D	Model E	Model F
Acres in lease	1,600	2,560*	2,560*
Acres per well (well spacing)	160	320	640
Number of producing wells	10	7	3
Number of dry holes	2	1	1
Number of disposal wells (converted dry holes)	1	1	1

*Maximum allowable acreage 2,560

	Model D		Model E		Model F	
	D	P	D	P	D	P
1. Acres Per Well						
a. Roads	2.00	4.00	1.50	3.00	1.00	2.00
b. Well Sites	2.00	0.01	3.00	0.01	4.00	0.01
c. Flowlines	1.00	0	1.00	0	1.00	0
Total Per Well	5.00	4.01	5.50	3.01	6.00	2.01
2. Acres Per Lease						
a. Tank battery	0	0.35	0	0.35	0	0.35
b. Office and storage	0	1.00	0	1.00	0	1.00
c. Water-yard-disposal	0	0.50	0	0.50	0	0.50
Total Per Lease	0	1.85	0	1.85	0	1.85

	Model D		Model E		Model F	
	D	P	D	P	D	P
3. Total Acres						
a. Well acres	50.00	40.10	38.50	21.07	18.00	6.03
b. Dry holes-disposal well	8.00	4.01	4.50	3.01	5.00	2.01
c. Other lease areas	0	1.85	0	1.85	0	1.85
Total Acres	58.00	45.96	43.00	25.93	23.00	9.89
4. Percent of Lease Area Used	3.6	2.9	1.7	1.0	0.9	0.4
5. Acres Used Per Well	4.8	4.2	5.4	3.2	5.7	2.4
6. Acres Used Per Sq. Mile	19.2	16.8	10.8	6.4	5.7	2.4

ASSUMPTIONS

1. Roads: Development--9 feet wide; production--18 feet wide.
2. Wells: Drilling--3/4 to 4 acres per location; producing or injection--21 feet by 21 feet location.
3. Flowline: Ditches 54 inches deep by 16 inches wide; temporary surface disturbance 4 feet on each side of centerline during construction.
4. Tank battery, etc.: Includes 3 tanks for production, 1 tank for testing, 2 separators, 1 heater-treater, 1 gas flare line and 1 tank vent.
5. Water disposal: 1 dry hole converted to a water disposal well.

The areas shown in the models are adequate for most field operations. The amount of ground used in actual operations may be greater in some areas and less in others. An example is a 1,500-2,000 foot gas well drilled in northern Montana. The spacing is one well per section. The area needed to drill this well is approximately 50 feet by 50 feet as a truck-mounted drilling rig is used to drill the well. If the location is reasonably flat there is no removal of the vegetation, just damage from driving across the vegetation.

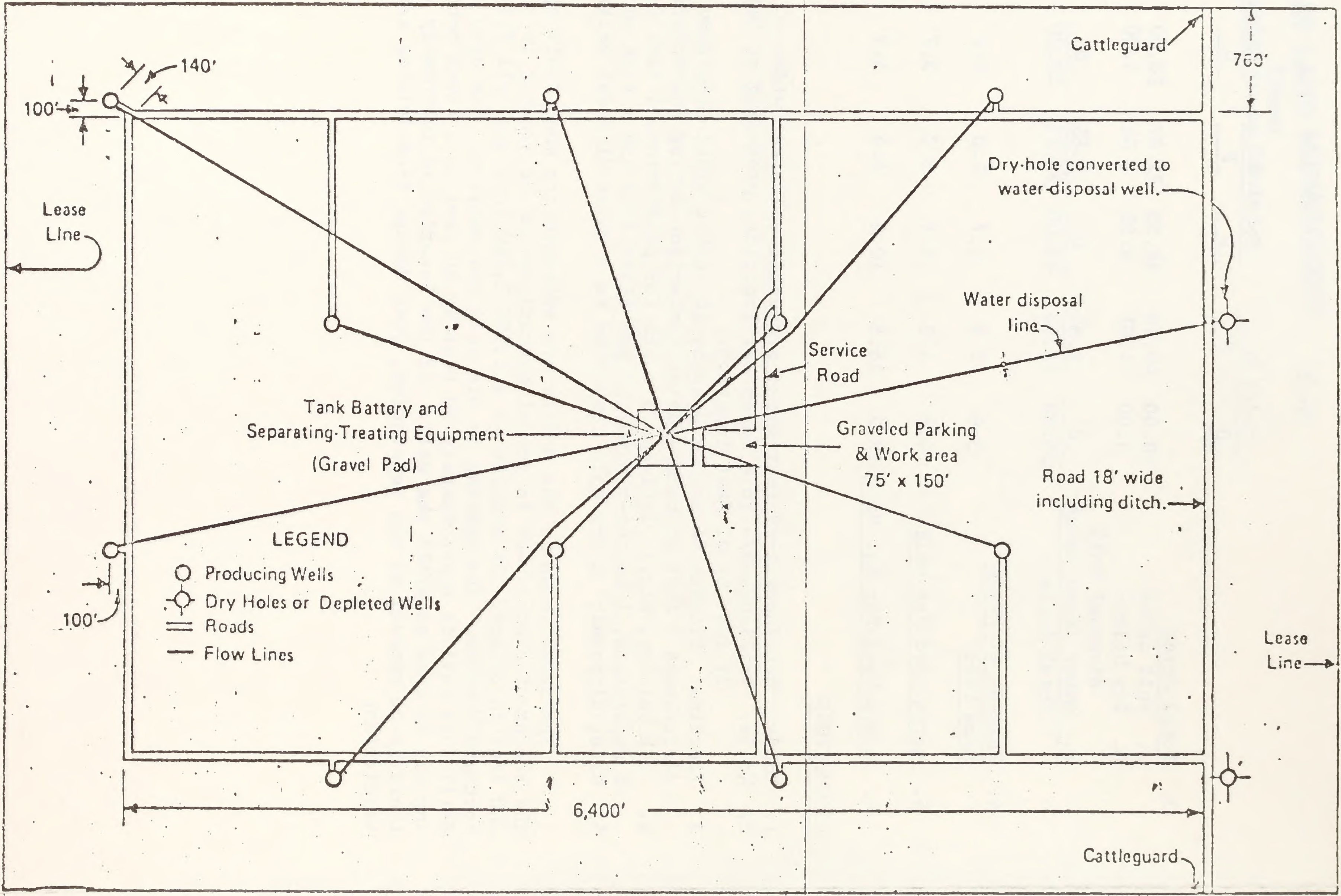
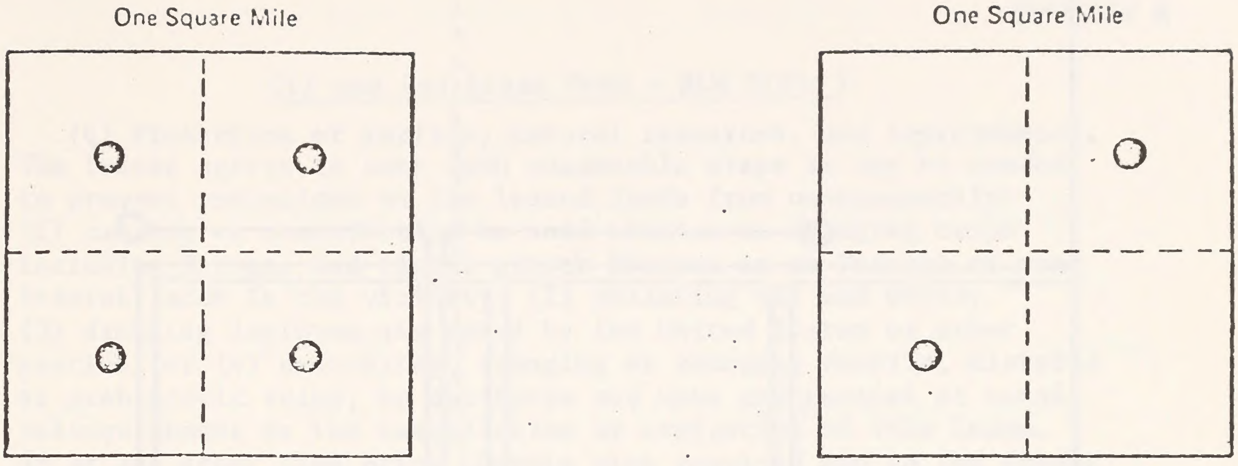
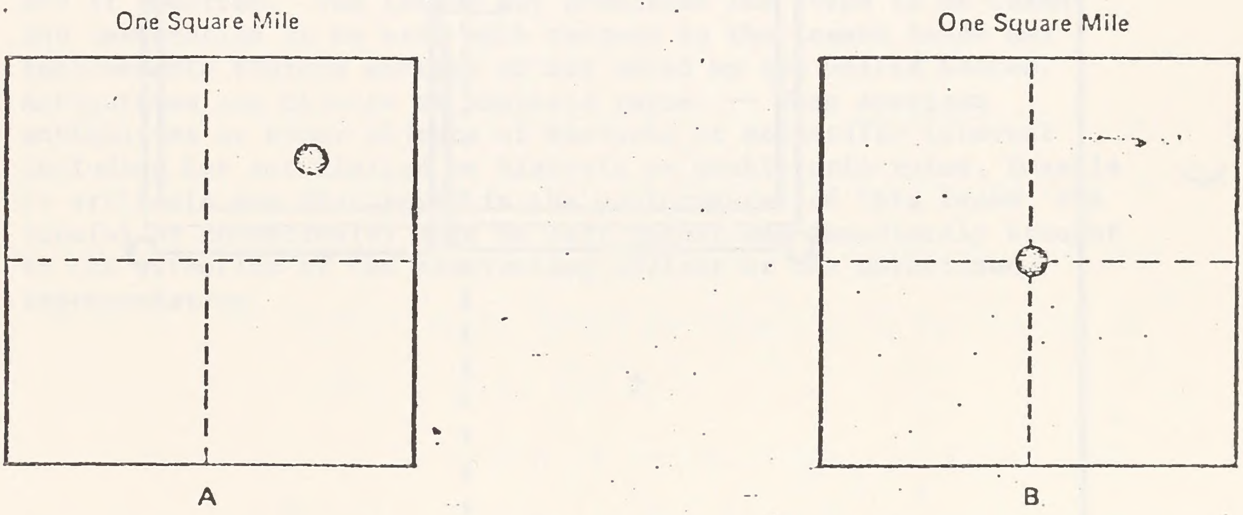

Cattleguard
760'
140'
100'
Lease
Line
Dry-hole converted to
water-disposal well.
Water disposal
line
Service
Road
Tank Battery and
Separating-Treating Equipment
(Gravel Pad)
Graveled Parking
& Work area
75' x 150'
Road 18' wide
including ditch.
LEGEND
Producing Wells
Dry Holes or Depleted Wells
Roads
Flow Lines
100'
Lease
Line
6,400'
Cattleguard

Fig. 1-C-1. Possible layout for a 960-acre lease with 10 producing wells established on an 80-acre per well spacing pattern


One Square Mile
One Square Mile

Well locations in a 160-acre per well spacing pattern.

Well locations in a 320-acre per well spacing pattern.


One Square Mile
One Square Mile
A
B

Alternative well locations for 640-acre per well spacing pattern. If 160-acre or 320-acre well spacing patterns are adopted at a later time to provide for additional petroleum recovery, pattern "A" will permit additional wells to be drilled in the section; pattern "B" will not.

Figure 1-C-2. Well locations commonly used for 160-acre, 320-acre and 640-acre per well spacing patterns

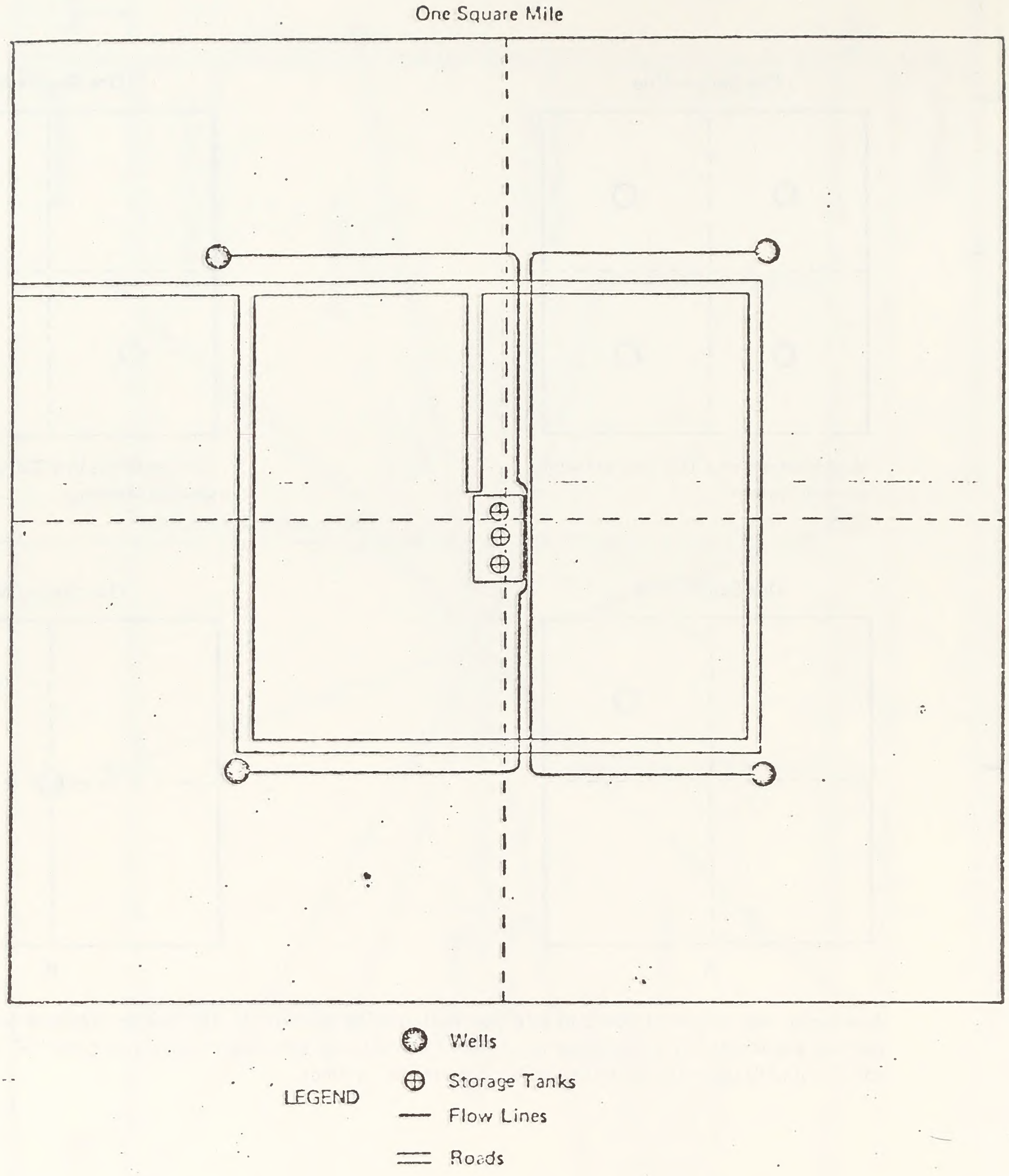

One Square Mile
LEGEND
Wells
Storage Tanks
Flow Lines
Roads

Figure 1-C-3. Possible layout for wells, roads, flow lines and storage tanks for a 160-acre per well spacing pattern

Oil and Gas Lease Form - BLM 3120-3

(q) Protection of surface, natural resources, and improvements. The lessee agrees to take such reasonable steps as may be needed to prevent operations on the leased lands from unnecessarily: (1) causing or contributing to soil erosion or damaging crops, including forage, and timber growth thereon or on Federal or non-Federal lands in the vicinity; (2) polluting air and water; (3) damaging improvements owned by the United States or other parties; or (4) destroying, damaging or removing fossils, historic or prehistoric ruins, or artifacts and upon any partial or total relinquishment or the cancellation or expiration of this lease, or at any other time prior thereto when required and to the extent deemed necessary by the lessor to fill any pits, ditches and other excavations, remove or cover all debris, and so far as reasonably possible, restore the surface of the leased land and access roads to their former condition, including the removal of structures as and if required. The lessor may prescribe the steps to be taken and restoration to be made with respect to the leased lands and improvements thereon whether or not owned by the United States. Antiquities and objects of historic value. -- When American antiquities or other objects of historic or scientific interest including but not limited to historic or prehistoric ruins, fossils or artifacts are discovered in the performances of this lease, the item(s) or condition(s) will be left intact and immediately brought to the attention of the contracting officer or his authorized representative.

CULTURAL RESOURCE STIPULATIONS TO OIL AND GAS LEASES ISSUED IN OREGON

Prior to any operations under this lease, the Lessee will engage a qualified professional, acceptable to the Authorized Officer, to make a survey of the land to be disturbed or occupied. A certified statement, signed by the qualified professional, setting out the steps taken in the survey and the findings thereof as to the existence of antiquites or other objects of historic or scientific interest, shall be submitted to the Authorized Officer. If the statement indicates the existence of such materials which might be disturbed by operations under this lease, the Lessee shall take such mitigating actions as may be required by the Authorized Officer, including, but not limited to, archeological salvage or protective measures or avoidance of the site, to protect and preserve such objects. Such objects shall remain the property of the Lessor, or the surface owner if other than the Lessor.

If a cultural resource is discovered during project operations, activities will be stopped until a survey of the materials is completed by a professional engaged by the lessee and acceptable to the Authorized Officer, including but not limited to archeological salvage or protective measures or avoidance of the site, to protect and preserve the materials. Such materials shall remain the property of the Lessor, or the surface owner if other than the Lessor.

State of Oregon
DEPARTMENT OF ENVIRONMENTAL QUALITY

INTEROFFICE MEMC

To: Mr. R. E. Corcoran, State Geologist
Department of Geology and Mineral Industries

Date: September 2, 1975

From: Mr. Loren Kramer, Director
Department of Environmental Quality

Subject: SPECIAL CONDITIONS TO APPLY TO ALL DEEP WELL EXPLORATORY DRILLING IN OREGON

1. If a geothermal, mineral or petroleum resource of commercial interest is discovered, no drilling of additional wells or operations in connection therewith shall commence until an Environmental Impact Statement has been prepared for utilizing and developing the resource.

2. Prior to commencement of any drilling activities where drilling depth is expected to be in excess of 1,000 feet, detailed plans and specifications shall be submitted to and approved by the Department of Environmental Quality for collection and disposal of drill cuttings and mud, and other potential waste materials.

3. A contingency plan shall be submitted to the Department of Geology and Mineral Industries prior to any deep well drilling activities outlining the following information procedures.
   a. Measures taken to prevent emergency conditions or unplanned discharges, such as blowouts.
   b. A description of preventive facilities to contain or treat unplanned discharges.
   c. The reporting system to be used to alert facility management and appropriate legal authorities.
   d. A list of personnel and equipment available to respond to emergency conditions.

4. Upon determination of the Director of the Department of Environmental Quality or the Director of the Department of Geology and Mineral Industries that any activities conducted by the permittee in relation to its drilling operations or activities may tend to or will cause damage, hazards, pollution or risk to the environment of Oregon or may violate any conditions of permits issued by the aforementioned departments, the permittee shall when notified either orally or in writing by the Director of either department immediately cease and desist its drilling operations or activities until the problem has been corrected.

5. All drilling processes and all waste mud and waste waters collection, treatment and disposal facilities shall be operated and maintained at all times in a manner which will prevent a direct discharge or indirect discharge of any waste mud and waste waters to the waters of the state.

6. All waste mud and waste waters are to be discharged into self-contained, non-overflow holding ponds.

7. All access roads, trails, drainage systems and the drilling site shall be constructed and maintained to minimize soil disturbances, control erosion and prevent channeling.

8. All refuse shall be disposed of at a refuse site which has a valid permit from the Department of Environmental Quality.

9. No geothermal waters, mineralized waters, oily waters or other waters or substances which might cause the Water Quality Standards of the State of Oregon to be violated shall be discharged or otherwise allowed to reach any of the waters of the state unless a permit for the discharge has been issued by the Department of Environmental Quality.

10. Sanitary wastes shall be disposed of in chemical or gas fired toilet facilities which have been installed in accordance with the recommendations of the Department and the local county health department or by other approved means.

11. In the event a breakdown of equipment or facilities causes a violation of any of the conditions of this permit or results in any unauthorized discharge, the permittee shall:

    a. Immediately take action to stop, contain and clean up the unauthorized discharges and correct the problem.

    b. Immediately notify the Department of Environmental Quality and the Department of Geology and Mineral Industries so that an investigation can be made to evaluate the impact and the corrective actions taken and determine additional action that must be taken.

    c. Submit a detailed written report describing the breakdown, the actual quantity and quality of resulting waste discharges, corrective action taken, steps taken to prevent a recurrence and any other pertinent information.

    Compliance with these requirements does not relieve the permittee from responsibility to maintain continuous compliance with the conditions of this permit or the resulting liability for failure to comply.

12. Authorized representatives of the Department of Environmental Quality or the Department of Geology and Mineral Industries shall be permitted access to the premises of all facilities owned and operated by the permittee at all reasonable times for the purpose of making inspections, surveys, collecting samples, obtaining data and carrying out other necessary functions related to this permit.

APPENDIX K

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ROAD SPECIFICATIONS

INDEX

100 - GENERAL

200 - CLEARING AND GRUBBING

300 - EXCAVATION AND EMBANKMENT

400 - CORRUGATED METAL PIPE

500 - RENOVATION OF EXISTING ROADS

600 - WATERING

700 - AGGREGATE BASE COURSE (PIT-RUN)

1000 - AGGREGATE BASE COURSE (CRUSHED ROCK)

1300 - AGGREGATE SURFACE COURSE (CRUSHED ROCK)

1400 - SLOPE PROTECTION

Note: Due to length, the specifications are not printed here. Complete copies are available to all interested parties from the Eugene District Office.

APPENDIX L

MISCELLANEOUS CONSTRUCTION, DEVELOPMENT, OPERATION AND RECLAMATION STIPULATIONS

1. Lessee shall maintain roads it is authorized to build in a condition suitable for use by passenger type vehicles and to reasonably protect such road from winter weather.

2. Whenever the Lessee uses roads owned or controlled by the United States for the transportation of petroleum products or by-products resulting from operations of lessee, it shall be responsible for road maintenance as follows:

   (a) If the road is maintained by the United States or its licensees, the lessee shall pay the United States a maintenance fee during periods of use by lessee. Such maintenance fee shall be determined by the Authorized Officer of the Bureau of Land Management.

   (b) If the road is not being maintained by the United States or its licensees, the lessee shall maintain said road during periods of use by it in as good a condition as prior to its use, and the lessee shall be entitled to collect maintenance expense from others who use the road for commercial hauling purposes including the United States and its licensees.

3. Roads and drill pads constructed and/or used by the lessee shall be surfaced by lessee if intended for wet season or long term use.

4. An unsurfaced road constructed by the lessee shall be ripped, water barred and revegetated with native plant species by lessee, as directed by the District Engineer, Geological Survey, when such road is no longer needed by lessee.

5. Cut and fill slopes and exposed banks resulting from construction activities by lessee shall be seeded, fertilized and mulched by lessee as directed by the District Engineer, Geological Survey.

6. Road location and design shall be such that excavation will not remove support from the base of over-steepened slopes or remove the toe of previous slides.

7. Cut and fill slopes designed to exceed the normal angle of repose shall include slope stabilizing measures such as riprap, rock buttresses, bin or retaining walls, piling and horizontal drains.

8. The sidecast of excavated material shall be prohibited on critical slopes (i.e. slopes over 60 percent) and endhaul of such material shall be required.

9. Lessee shall incorporate appropriate measures in its design of stream crossings to limit the need for stream channel relocations and to assure that increases in water velocity will be minimal.

10. Lessee shall refrain from diverting water from streams when such diversion will reduce stream flow below that minimum recommended to the Oregon State Water Resources Board by the Oregon State Game Commission as published in Appendix D to the Willamette Basin Comprehensive Study, dated 1969, as prepared by the Willamette Basin Task Force - Pacific Northwest River Basins Commission.

11. In order to (minimize watershed damage)(protect important wildlife habitat) exploration, drilling and other development activity will be allowed only during the period from to This limitation does not apply to the maintenance and operation of producing wells. Exceptions to this limitation in any year may be specifically authorized in writing by the District Engineer, Geological Survey, with the concurrence of the Authorized Officer, Bureau of Land Management.

12. Lessee shall not sever or damage trees identified as nesting sites of the Northern Spotted Owl without specific authority by the District Engineer, Geological Survey, with the concurrence of the Authorized Officer, Bureau of Land Management.

13. In order to minimize disturbance of elk, Lessee shall control vehicular access over road as constructed by Lessee. Only vehicles of Lessee and others authorized by the District Engineer, Geological Survey, shall be provided access. Following Lessee's need for the use of such road, Lessee shall reclaim the right-of-way and block vehicular access except as it may be specifically directed otherwise by the District Engineer, Geological Survey.

14. Lessee shall reclaim sites for drill pads, tank batteries and associated facilities when such sites are no longer needed by Lessee. Such reclaimation shall include during the clearing and preparation of a site the stockpiling of top soil. Such stockpiles shall be contoured and seeded in a manner which will minimize erosion. In additon the site shall be revegetated with native species common to the site prior to development.

15. Lessee shall, in the location and design of roads, trails, pipelines and powerlines requiring rights-of-way greater than 10 feet in width, make use of topographic and vegetative features to minimize the discordant effect of continuous linear clearings.

16. Lessee shall design clearings for drill pads, tanks, batteries and other storage facilities to include a vegetative buffer when such clearings would be visible from (road)(recreation site).

17. Lessee shall paint, with nonreflective paints that blend with the landscape, all pumps, tanks, pipelines and other production related facilities that would be visible from   (road)(recreation site).

18. Lessee shall dispose of drilling mud only on sites approved in writing by the District Engineer, Geolgical Survey, with the concurrence of the Authorized Officer, Bureau of Land Management.

19. Lessee shall install suitable mufflers and/or sound dampening housings over pumps and motors when such equipment is creating, as determined by the Authorized Officer, Bureau of Land Management, noise disturbance in nearby residences or recreation sites.

STATEWIDE OVERVIEW OF POSSIBLE DEVELOPMENT ON FEDERAL OIL AND GAS LEASES IN OREGON

Introduction

This appendix is an overview of the development which could occur on Federal oil and gas leases in Oregon. The number and location of leases and pending applications in the State are described; and the possible levels of ensuing oil and gas exploration and production activities are considered.

The anticipated environmental effects of exploration and production activities are analyzed in the main body of environmental analysis records prepared for individual blocks of lease applications.

If commercial quantities of oil or gas are found in the State, transportation facilities would be required; and discoveries of oil could lead to the construction or enlargement of refineries. Analysis of the environmental effects of transportation and refining facilities is beyond the scope of the environmental analyses of the lease applications. However, the potential for, and possible magnitude of, pipeline and refinery construction are examined in this appendix. The principal environmental permit and certification processes required of proposed pipeline and refinery projects in Oregon are also described.

As of February 9, 1976, 212 applications for Federal oil and gas leases were on file in Oregon. The applications covered 387,636 acres. In addition, 193,467 acres were already under lease. The total area included in both existing leases and pending applications was 581,103 acres. Areas containing Federal leases and pending lease applications in Oregon are shown in Figure 1.

Exploratory Drilling

If pending lease applications were approved, at least four or five exploratory wells probably would be drilled on Federal or intermingled private or State land during the next several years. If early tests were favorable, 20 or more wildcat wells might be drilled on lease blocks containing Federal lands.

Many Federal oil and gas leases expire without being explored for oil and gas. This is particularly true outside areas classified by the U.S. Geological Survey as known geologic structures. Since there are no known geologic structures in Oregon, exploratory oil and gas wells probably would be drilled on a relatively small percentage of the leases during the next several years. If oil or gas were discovered, additional exploratory wells would be drilled.

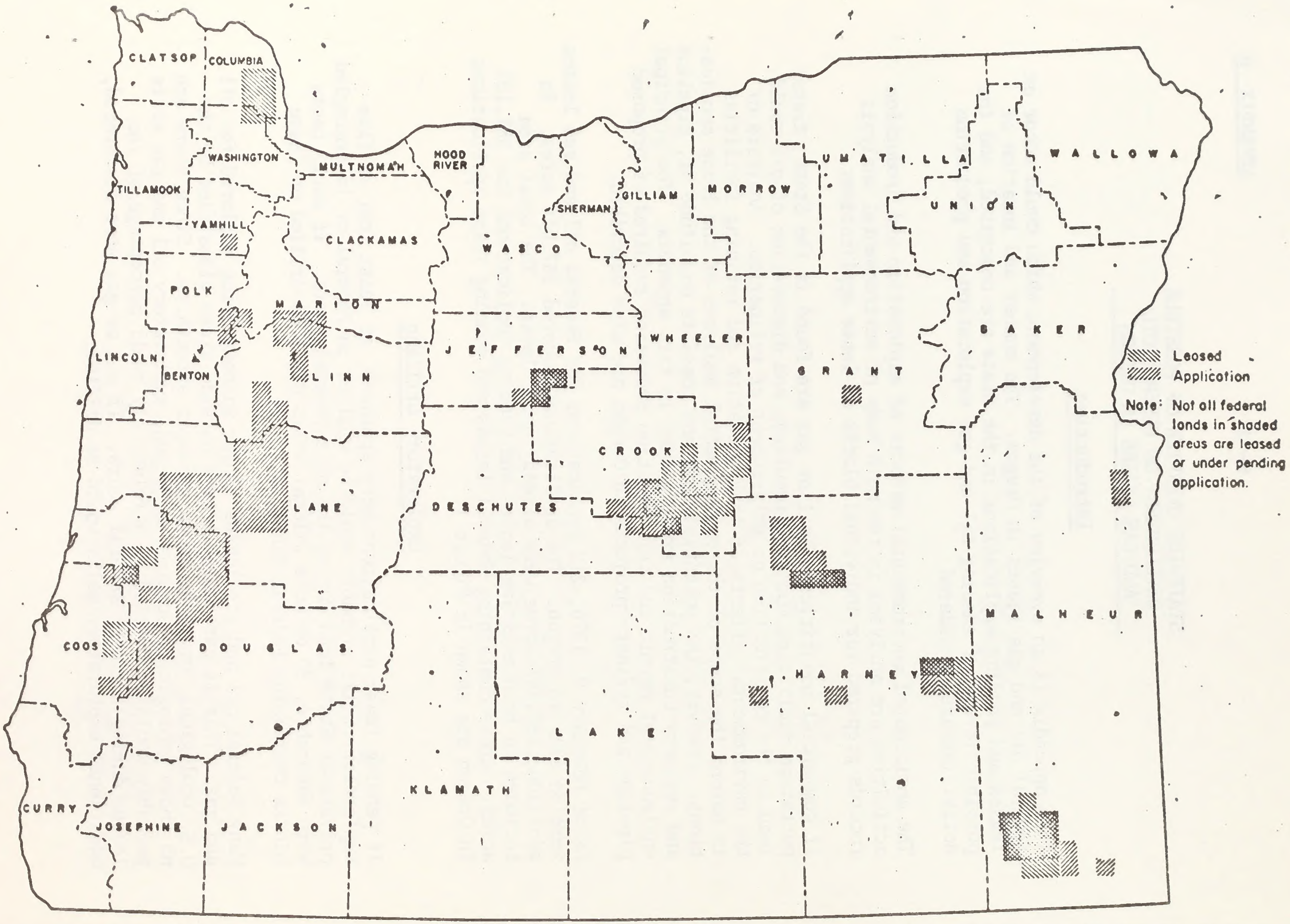

CLATSOP
COLUMBIA
WASHINGTON
MULTNOMAH
HOOD RIVER
TILLAMOOK
YAMHILL
CLACKAMAS
POLK
MARION
LINCOLN
BENTON
LINN
LANE
COOS
DOUGLAS
CURRY
JOSEPHINE
JACKSON
KLAMATH
WASCO
SHERMAN
GILLIAM
MORROW
UMATILLA
UNION
WALLOWA
JEFFERSON
WHEELER
GRANT
BAKER
CROOK
DESCHUTES
LAKE
HARNEY
MALHEUR
▨ Leased
▨ Application
Note: Not all federal lands in shaded areas are leased or under pending application.

FIGURE I Areas containing Federal Oil and Gas Leases and Pending Application for Federal Oil and Gas Leases in Oregon, as of February 9, 1976.

The petroleum industry's interest in exploration for oil and gas in Oregon has fluctuated over the years, but it now appears to be increasing. One indication of industry interest in the State is the acreage of Federal oil and gas leases. The total area included in Federal leases in Oregon dropped from a peak of 1,079,740 acres in 1956 to 22,892 acres in 1967. Since 1967, the acreage leased or under application has risen steadily; in early 1976, it stood at 581,103 acres. Oil companies also were reported to be leasing substantial areas of private land in 1975 and early 1976, particularly in the Willamette Valley.

Exploration activities increased in the State in 1975, and it appears that the momentum will extend at least through the next two to three years. Mobil Oil, the major applicant for Federal leases in western Oregon, conducted geophysical and geochemical sampling surveys in the State. Reichold Energy Corporation and Northwest Natural Gas Company drilled four dry holes in western Oregon in 1975 in search of natural gas.

The number and location of lease and lease application blocks provide a general indication of the number and location of exploratory wells which might be drilled during the next several years. Identification of lease blocks in some areas is complicated by the intermingling of leaseholds and lease applications of two or more companies. However, there appear to be about 15 lease or lease application blocks on Federal lands in the State at the present time.

If the first well drilled in a lease block is unsuccessful, it might be the only well drilled in the block during the current cycle of exploratory activity. Many years may pass before the current or a succeeding lessee concludes that another well is warranted. Wells might not be drilled in some blocks if exploration of nearby blocks is unsuccessful. Other blocks might remain unexplored because of the inability of the lessee to secure financing for a drilling operation. In a large block held by a large company, two or more dry holes might be drilled before drilling operations are stopped.

Almost all of the pending lease applications for Federal lands in western Oregon were filed by Mobil Oil; and if a significant portion of the applications is approved, it is likely that more than one exploratory well will be drilled in the company's large lease block. A petroleum engineer for the Oregon Department of Geology and Mineral Industries believes that the company is planning to drill several deep test holes in the next two to three years. (1)

Approximately one acre is required for the drill pad for an exploratory well. Somewhat more land would be needed on sloping land. On a well-per-well basis, more land might be disturbed in the construction of drill pads in western than in eastern Oregon. Because of the road system already developed to harvest timber and the cost of road construction in steep terrain, most wildcat wells in western Oregon probably would be drilled in locations which minimize the need for temporary access roads. In eastern Oregon, wildcat wells would be more likely to require the construction of access roads.

Oil and Gas Production

Recent experience of the oil and gas industry in the United States may provide a general indication of the possible outcome of oil and gas exploration in Oregon. As indicated in Table 1, the chances of discovering a significant recoverable reserve of oil or gas in the nation in 1974 were approximately 1 in every 59 new-field wildcat wells drilled. When a significant discovery was made in 1974, the odds were greater than 9 to 1 that the area of the field would be less than 2 square miles.

TABLE 1

NEW-FIELD WILDCAT WELLS DRILLED IN U.S. IN 1974: NUMBER AND PERCENT OF DRY HOLES AND PRODUCERS BY CLASS OF OIL AND GAS FIELD

Class of Field 3/	Total Recoverable 3/ Reserves by Field Class		Area of Oil Fields 1/		Number and Percent of 2/ New-Field Wildcats Drilled in 1974, by Field Class	
	Oil (Mill. Brls.)	Gas (Bill. Cu. Ft.)	Denver-Julesburg Basin. Co. (Sq. Mi.)	California (Sq. Mi.)	Number	Percent
I. Producers					805	14.24
A. Significant					(96)	(1.70)
A	+50	+300	--	--	0	0
B	25-50	150-300	9.7	1.7	1	0.02
C	10-25	60-150	5.2	1.1	7	0.12
D	1-10	6-60	1.4	0.4	88	1.56
B. Not Significant						
E	Less than 1	Less than 6	0.6	0.2	707	12.51
F	Abandoned				2	0.3
II. Dry Holes					4847	85.76
Total New-Field Wildcats Drilled in U.S. in 1974					5652	100.00

1/ H. W. Menard and G. Sharmen. 1975. "Scientific Uses of Random Drilling Models." Science. Vol. 190, No. 4212.

2/ F. J. Wagner, 1975. "North American Drilling Activity in 1974." Bulletin of the American Association of Petroleum Geologists. Vol. 58, 1273.

3/ Field classifications and "significance" criteria established by American Association of Petroleum Geologists.

All of the 189 oil and gas wells drilled in Oregon since 1902 have been dry holes. In the opinion of the staff of the Oregon Department of Geology and Mineral Industries, however, "There is still potential for finding deposits of oil and gas in Oregon in spite of many past drilling failures . . . . Results of deep drilling have been generally discouraging, but they have shown that there is a thick section of marine sedimentary rocks and that at many locations porous and permeable sands exist within the stratigraphic section." (2) Past drilling in the State has produced numerous shows of oil and gas, but none has been in commercial quantities.

One indication of the chances of discovering commercial quantities of oil and gas in Oregon may be the discovery rate for all new-field wildcat wells in the country. As indicated in Table 1, of the 5652 new-field wildcat wells drilled in the United States in 1974, 805--or one in seven--were finished as producers. However, only 96--or one in 59--resulted in the discovery of fields with significant recoverable reserves.(3) The American Association of Petroleum Geologists considers significant reserves to be those over one million barrels, the amount required to meet the country's petroleum demand for one and one-half hours. The percentage of significant oil or gas finds in total new-field wildcat wells drilled in the United States declined from over three percent in the late 1940's to 1.7 percent in 1974.(4)

Recent drilling experience also provides an indication of the size of field most likely to be discovered. Over the years, a growing percentage of the significant discoveries has been in smaller fields. In the late 1940's, 20 to 25 percent of the significant oil and gas discoveries were in Class "D" fields, the smallest fields in the American Association of Petroleum Geologists' rankings.(5) As indicated in Table 1, 88 of the 96 significant new-field discoveries in 1974, or 92 percent, were in Class "D" fields. From 1968 to 1974, 84 percent of the signficant discoveries were in Class "D" fields.

Table 1 also relates classes of oil and gas fields, as determined by total recoverable reserves, to the area of oil fields in Colorado and California. Class "D" fields average approximately one-half square mile in California and one and one-half square miles in the Denver-Julesburg Basin in Colorado. The average sizes of the fields in each class in the Denver-Julesburg Basin approximate those for the nation as a whole.(6)

It appears, therefore, that if oil or gas is found in Oregon, the chances are better than even that the field will be less than two square miles in size.

The American Association of Petroleum Geologists refers to Class "A" oil and gas fields as "giants." From 1968 to 1974, only 3.1 percent of the significant discoveries in the United States was in giant fields. No giant fields were discovered in the country in 1973 and 1974 (1975 data are not available).(7) Although the chances of a giant field being discovered in Oregon are probably slight, the possibility remains. Examples of large oil fields in California include the 46-square mile Midway Sunset and 60-square mile Elk Hills fields. The Rio Vista and Sutter Buttes fields are large gas fields in California; both are approximately one square township, or 36 square miles, in area.(8)

The amount of land used in a field for roads, well sites, and other oil and gas field facilities depends largely upon the well spacing pattern. Gas wells tend to be more widely spaced than oil wells. Typical spacing patterns in recently developed fields in California are 10 acres per well in oil fields and 160 acres per well in gas fields.(9) In the Rocky Mountain area, spacing patterns range from 40 to 160 acres per well in most oil fields developed in recent years and from 160 to 640 acres per well in gas fields.(10)

The administrative rules of the Oregon Department of Geology and Mineral Industries require a minimum spacing pattern of 40 acres per well unless a different spacing pattern is approved by the department's governing board.

With a 40-acre-per-well spacing pattern, approximately 12.8 acres per square mile may be used for well sites, roads, and other facilities; with a 320-acre-per-well spacing pattern, about 6.4 acres per square mile may be used.

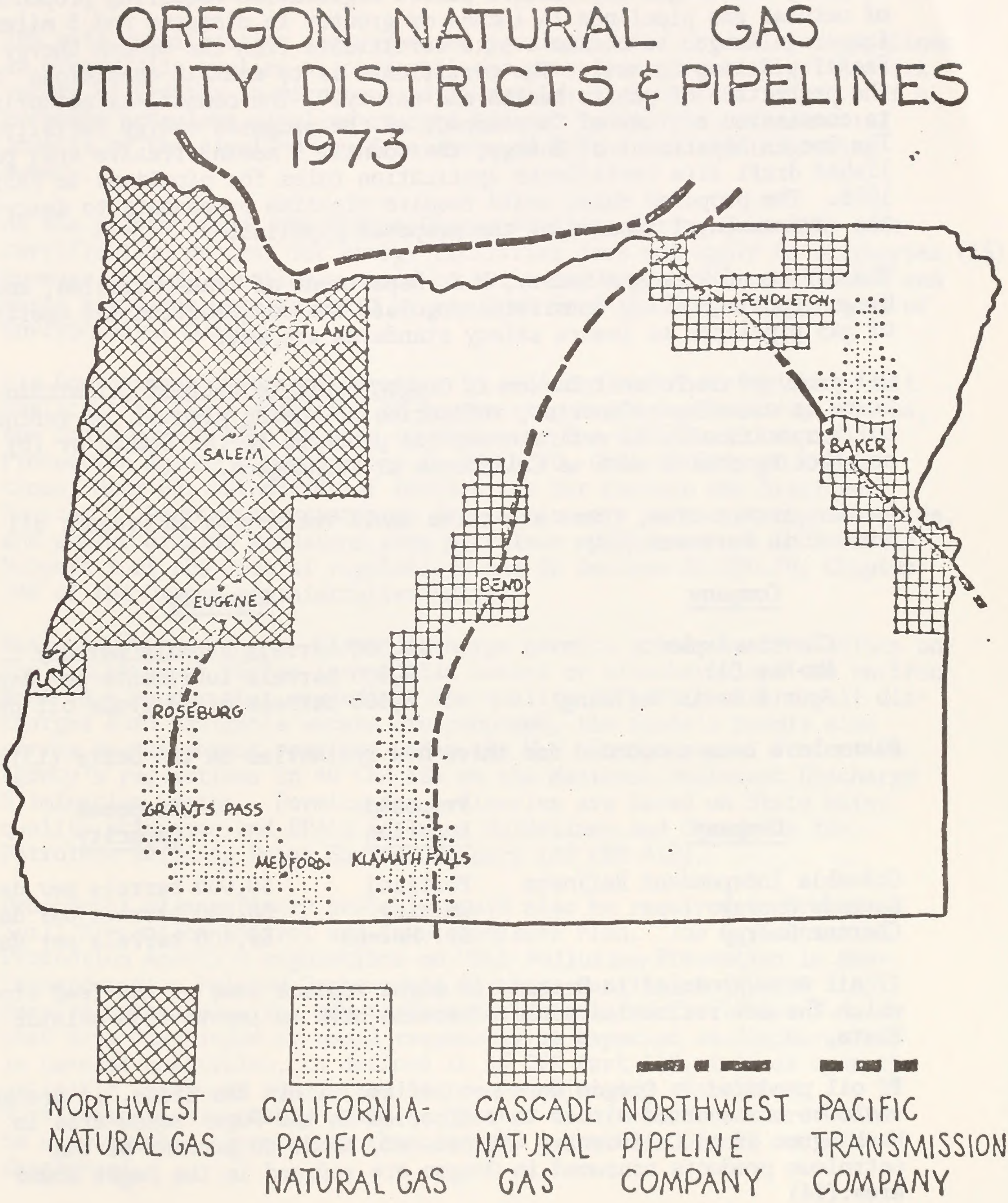
If a small, two-square mile field is discovered in Oregon, the amount of land used in the field may range from approximately 13 to more than 25 acres. If a large, 50-square mile field is discovered, more than 640 acres may be used for roads, well sites, and other facilities.

Transportation and Refining Facilities

If commercial quantities of natural gas were discovered in Oregon, it probably would be sold to natural gas utilities with marketing areas or pipelines in the vicinity of the gas fields. The boundaries of Oregon's natural gas utility districts and major pipeline routes are shown in Figure 2. (The West Coast leg of the proposed Alaska Natural Gas Transportation System natural gas pipeline would parallel all but 21.4 miles of the existing Pacific Gas Transmission Company route shown on the map). Except for those in southeastern Oregon, the lease and lease application blocks are located within a relatively short distance of major existing natural gas pipelines.

If the route of a proposed gas pipeline crossed Federal lands, the land-administering agency would prepare an environmental assessment or analysis record before issuing a right-of-way. (The environmental impacts of flowlines--as distinct from pipelines--constructed on the leasehold to carry gas from the wellhead to a central collection point would be analyzed by the U.S. Geological Survey and the land-administering agency after the lessee submitted a proposed surface use plan for the leasehold.) If anticipated environmental impacts of the proposed pipeline or public interest were determined to be significant, an environmental impact statement would be prepared.

FIGURE 2


OREGON NATURAL GAS
UTILITY DISTRICTS & PIPELINES
1973
PORTLAND
SALEM
EUGENE
ROSEBURG
GRANTS PASS
MEDFORD
KLAMATH FALLS
BEND
PENDLETON
BAKER
NORTHWEST NATURAL GAS
CALIFORNIA-PACIFIC NATURAL GAS
CASCADE NATURAL GAS
NORTHWEST PIPELINE COMPANY
PACIFIC TRANSMISSION COMPANY

SOURCE: Oregon Office of Energy Research and Planning, Transition: A Report to the Oregon Energy Council. January 1, 1975.

In 1975, the Oregon Legislature passed legislation requiring proponents of natural gas pipelines 16 inches or greater in diameter and 5 miles or longer in length to obtain a site certificate from the Oregon Energy Facility Siting Council. The certificate is to contain conditions "for the protection of public health and safety." The council is authorized to commission a study of "any aspect of the proposed energy facility."(11) The Oregon Department of Energy, the Council's administrative arm, published draft site certificate application rules for pipelines in February 1976. The proposed rules would require pipeline proponents to describe the environmental impacts of the proposed pipeline.

The Office of Pipeline Safety, U.S. Department of Transportation, and the Oregon Public Utility Commission regulate the construction and operation of gas pipelines to insure safety standards are met.

Oil produced on Federal leases in Oregon could be refined (a) within the State at existing refineries, refineries now being planned, or refineries built specifically to refine crude oil produced in the State; or (b) in neighboring states such as California or Washington.

At the present time, there are three small refineries in Oregon; all are located in Portland (12):

Company	Capacity
Chevron Asphalt	18,000 barrels asphalt per day
Nu-Way Oil	2,000 barrels lubricants per day
Ager & Davis Refining	3,500 barrels mixed grade oil per day

Plans have been announced for three new refineries in the State (13):

Company	Proposed Location	Proposed Capacity
Columbia Independent Refiners	Portland	50,000 barrels per day
Cascade Energy	Rainier	30,000 barrels per day
Charter Energy	St. Helens	52,400 barrels per day

If oil were produced in Oregon, it might replace some of the feed stocks which the new refineries would otherwise have to import from outside the State.

If oil produced in Oregon were not refined within the State, it probably would be transported either to refineries in the Puget Sound area in Washington or to California. At present, about 60 percent of the petroleum products consumed in Oregon are refined in the Puget Sound area.(14)

Unlike natural gas, many miles of new pipeline might be constructed to transport oil produced in the State. There are two petroleum product pipelines but no crude oil pipelines in the State. Other transportation modes might also be used.

The site certification process cited previously for natural gas pipelines in Oregon also applies to crude oil and petroleum product pipelines six inches or greater in diameter and five miles or longer in length. If a proposed petroleum pipeline crossed Federal lands, the environmental impacts of the pipeline would be assessed by the land-administering agency.

At the present time, the Oregon Energy Facility Siting Council's site certification process for energy facilities does not apply to refineries.(15) However, before a refinery could be built in Oregon, air contaminant and waste discharge permits would be required from the Oregon Department of Environmental Quality.

Air Contaminant Discharge Permit: In addition to requiring the permit applicant to limit emissions to levels stipulated in State regulations, the State permit also is used to implement the U.S. Environmental Protection Agency's regulations in Title 40, Code of Federal Regulations, Part 60, "Standards of Performance for Certain New Stationery Sources." Performance standards for particulate matter, carbon monoxide, and sulfur dioxide emissions from petroleum refineries are included in Subpart A of the Federal regulations and in Section 25-000.70, Chapter 340 of the Oregon Administrative Rules.

Waste Discharge Permit: Waste discharge permits prescribe limitations on the discharge of wastes into public waters or elsewhere into the environment in a manner that may affect the quality of public waters. If discharges into navigable waters are proposed, the State's permit also serves as the permit required under the U.S. Environmental Protection Agency's regulations in 40 CFR 125 on the National Pollutant Discharge Elimination System. Permits for refineries are based on State water quality standards and EPA's Effluent Guidelines and Standards for Petroleum Refining Point Source Category (40 CFR 419).

Proponents of a refinery probably would also be required to prepare a Spill Prevention Control and Countermeasure Plan. The Environmental Protection Agency's regulations on "Oil Pollution Prevention in Non-Transportation Related Onshore and Offshore Facilities (40 CFR 112) require such a plan for non-transportation related facilities ". . . that have discharged or could reasonably be expected to discharge oil in harmful quantities, as defined in 40 CFR Part 110, into or upon the navigable waters of the United States or adjoining shorelines. . . ." Most refineries probably would be located at sites where there would be a reasonable expectation that harmful quantities of oil could be discharged.

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3. F. J. Wagner. 1975. "North American Drilling Activity in 1974." Bulletin of the American Association of Petroleum Geologists. Vol. 58, 1273.
4. Ibid.
5. Ibid.
6. H. W. Menard and G. Sharman. 1975. "Scientific Uses of Random Drilling Models." Science. Vol. 190, No. 4212.
7. Op. cit.
8. Personal communication, William Lee, Conservation Division, U.S. Geological Survey, Menlo Park, CA.
9. Personal communication, John Fackler, Conservation Division, U.S. Geological Survey, Los Angeles, CA.
10. Personal communication, Wally Sutherland, Conservation Division, U.S. Geological Survey, DEnver, CO.
11. Oregon Revised Statutes 453.355.
12. Personal communication, Vernon Newton, Oregon Department of Geology and Mineral Industries, Portland, OR.
13. Ibid.
14. Oregon Office of Energy Research and Planning. 1975. Transition: A Report to the Oregon Energy Council. p. 55.
15. Personal communication, W. R. Vermeere, Oregon Department of Energy, Salem, OR.

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Mohawk-Dorena environme
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ENVIRONMENTAL ASSESSMENT RECORD

FOR PROPOSED

OIL AND GAS LEASING

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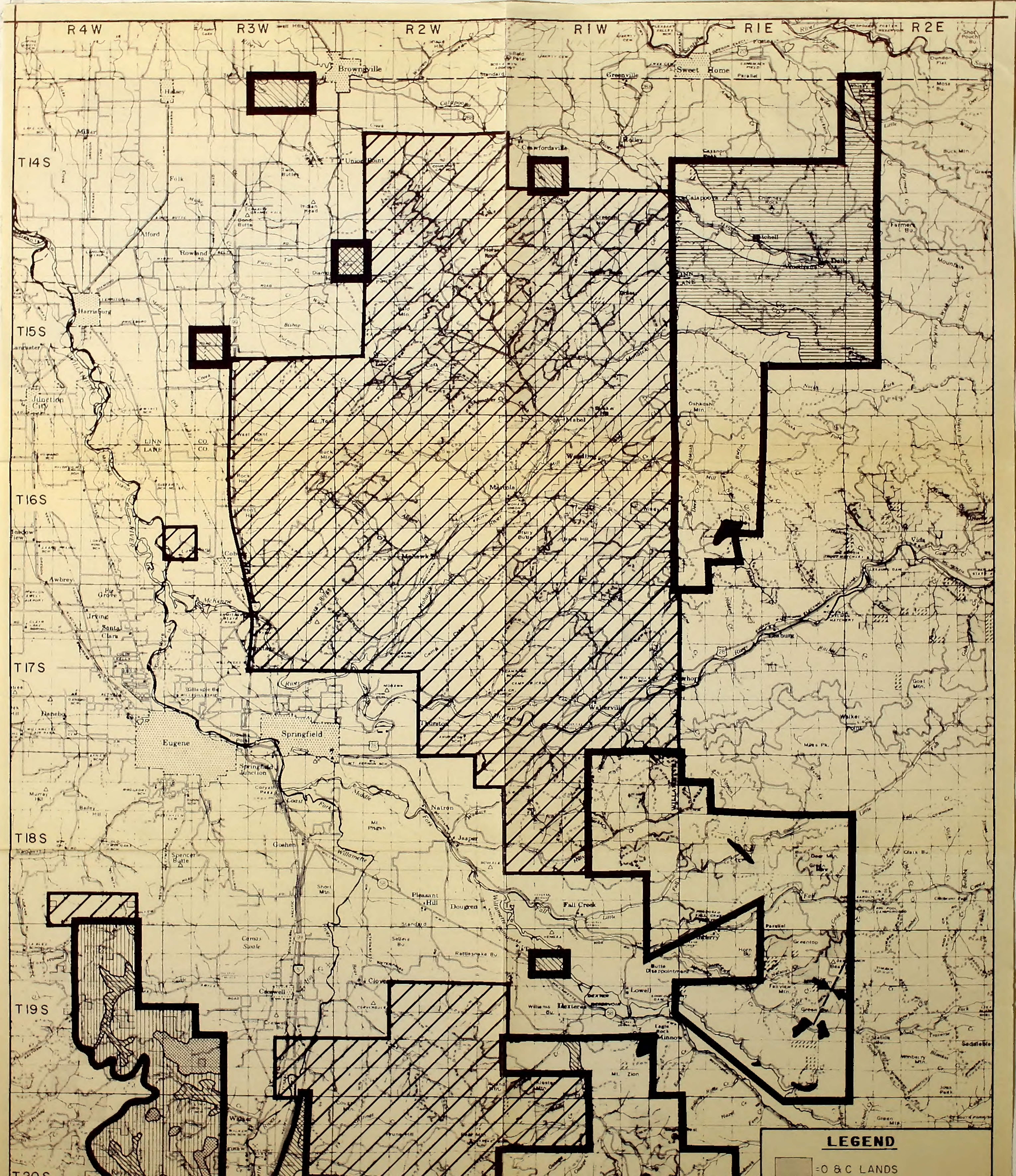
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Brownsville
Sweet Home
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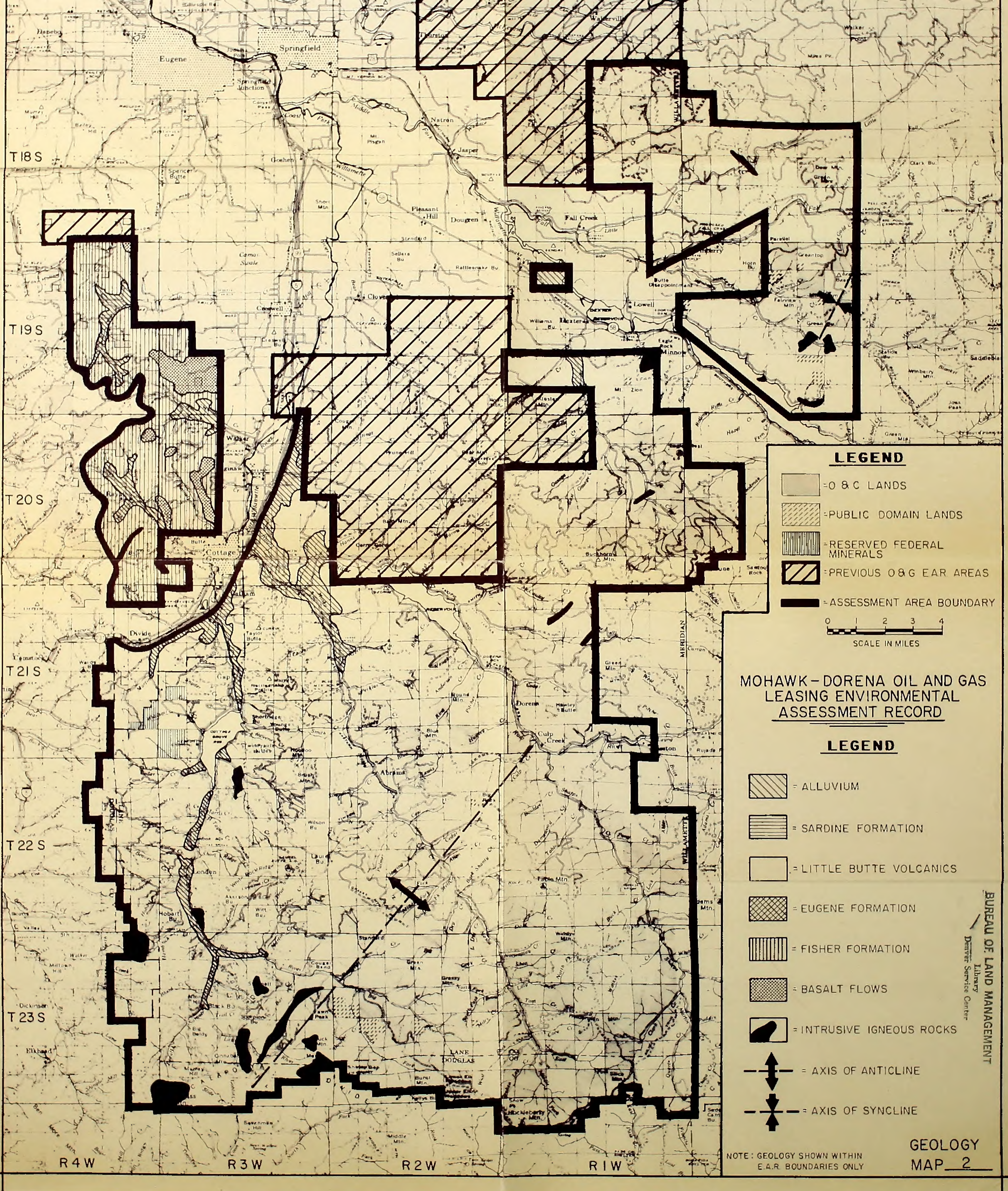
Greenville
Holley
Halsey
Union Point
Calapooya
Harrisburg
Junction City
Alford
Rowland
Folk
Mabel
Wendling
Marcola
Mohawk
Vida
Leaburg
Thurston
Walterville
Eugene
Springfield
Springfield Junction
Goshen
Natron
Jasper
Pleasant Hill
Dougren
Fall Creek
Lowell
Dexter
Creswell
Cloverdale
Spencer Butte
Mt. Pisgah
Coburg
Irving
Santa Clara
Awbrey
Danebo
Butte Disappointment
Mt. Zion
Walker Point
Goat Mtn.
LEGEND
=O & C LANDS


LEGEND
= O & C LANDS
= PUBLIC DOMAIN LANDS
= RESERVED FEDERAL MINERALS
= PREVIOUS O & G EAR AREAS
= ASSESSMENT AREA BOUNDARY
0 1 2 3 4
SCALE IN MILES
LEGEND
= ALLUVIUM
= SARDINE FORMATION
= LITTLE BUTTE VOLCANICS
= EUGENE FORMATION
= FISHER FORMATION
= BASALT FLOWS
= INTRUSIVE IGNEOUS ROCKS
= AXIS OF ANTICLINE
= AXIS OF SYNCLINE
T18S
T19S
T20S
T21S
T22S
T23S
R4W
R3W
R2W
R1W
MERIDIAN
Eugene
Springfield
Springfield Junction
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Natron
Jasper
Goshen
Pleasant Hill
Dougren
Fall Creek
Lowell
Dexter
Cloverdale
Creswell
Cottage Grove
Saginaw
Walker
Divide
Dorena
Culp Creek
Abrams
London
Hobart Bu.
Spencer Butte
Mt. Pisgah
Mt. Zion
Eagle Rock
Minnow
Buckhorn Mtn.
Green Mtn.
Blue Mtn.
Round Mtn.
Brushy Mtn.
Wilson Bu.
Wolf Bu.
Fairview Mtn.
Greentop
Deer Mtn.
Clark Bu.
Saddleblanket
Bohemia Mtn.
Huckleberry Mtn.
LANE
DOUGLAS
Elkhead
Dickinson
Mt. Juniper
Williams Bu.
Rattlesnake Bu.
Sellers Bu.
Short Mtn.
Walker Point
Adams Mtn.
Windy Mtn.
Zenith Mtn.
Bear Peak
Burnt Mtn.
Black Bu.
Big Baldy
Taylor Butte
Yoncalla
Camas Swale
Willamette
Coast Fork
Middle Fork
Row River
Mosby Cr.
Sharps Cr.
Brice Cr.
Layng Cr.
Smith Cr.
Lost Cr.
Little Fall Cr.
Winberry
Hills Creek
Fern Ridge
NOTE: GEOLOGY SHOWN WITHIN E.A.R. BOUNDARIES ONLY

MOHAWK – DORENA OIL AND GAS LEASING ENVIRONMENTAL ASSESSMENT RECORD

GEOLOGY MAP 2

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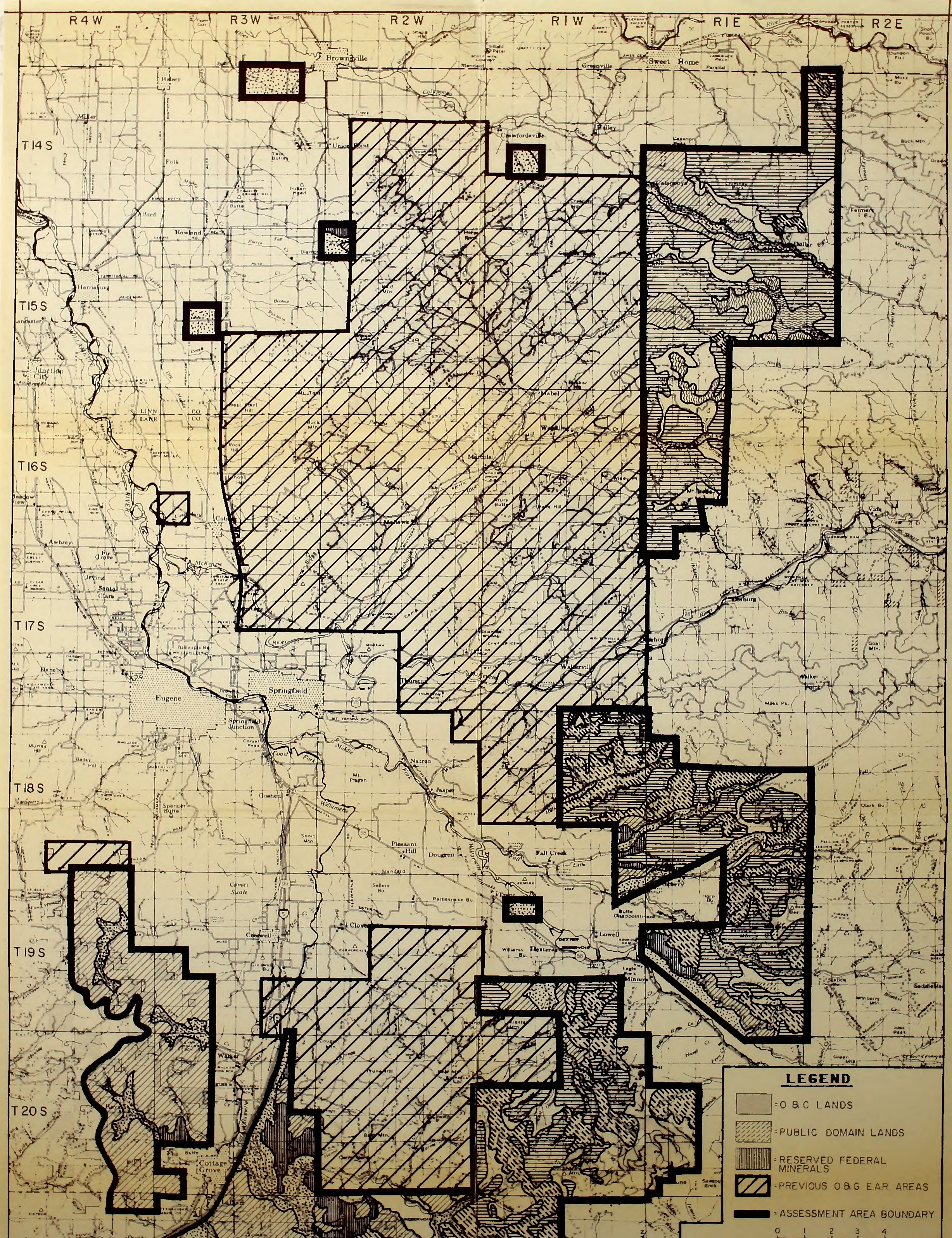
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Brownsville
Sweet Home
Crawfordsville
Halsey
Harrisburg
Junction City
Eugene
Springfield
Cottage Grove
Lowell
Pleasant Hill
Goshen
Jasper
Fall Creek
Coburg
Walterville
Vida
LEGEND
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= PUBLIC DOMAIN LANDS
= RESERVED FEDERAL MINERALS
= PREVIOUS O & G EAR AREAS
= ASSESSMENT AREA BOUNDARY
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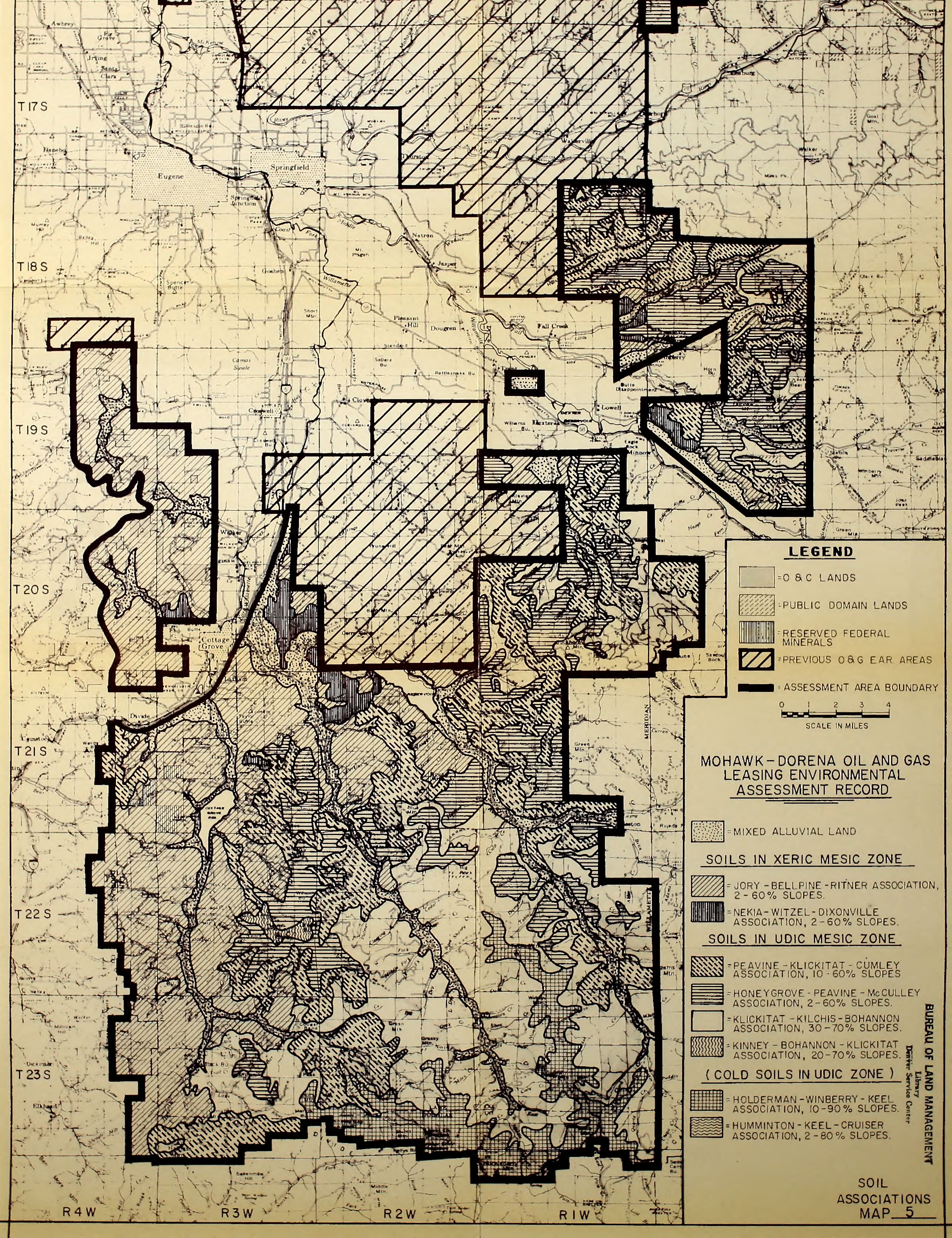
LEGEND
= O & C LANDS
= PUBLIC DOMAIN LANDS
= RESERVED FEDERAL MINERALS
= PREVIOUS O & G EAR AREAS
= ASSESSMENT AREA BOUNDARY
0 1 2 3 4
SCALE IN MILES
MOHAWK - DORENA OIL AND GAS LEASING ENVIRONMENTAL ASSESSMENT RECORD
= MIXED ALLUVIAL LAND
SOILS IN XERIC MESIC ZONE
= JORY - BELLPINE - RITNER ASSOCIATION, 2 - 60% SLOPES.
= NEKIA - WITZEL - DIXONVILLE ASSOCIATION, 2 - 60% SLOPES.
SOILS IN UDIC MESIC ZONE
= PEAVINE - KLICKITAT - CUMLEY ASSOCIATION, 10 - 60% SLOPES
= HONEYGROVE - PEAVINE - McCULLEY ASSOCIATION, 2 - 60% SLOPES.
= KLICKITAT - KILCHIS - BOHANNON ASSOCIATION, 30 - 70% SLOPES.
= KINNEY - BOHANNON - KLICKITAT ASSOCIATION, 20 - 70% SLOPES.
(COLD SOILS IN UDIC ZONE)
= HOLDERMAN - WINBERRY - KEEL ASSOCIATION, 10 - 90% SLOPES.
= HUMMINTON - KEEL - CRUISER ASSOCIATION, 2 - 80% SLOPES.
SOIL ASSOCIATIONS
MAP 5
T17S
T18S
T19S
T20S
T21S
T22S
T23S
R4W
R3W
R2W
R1W
Eugene
Springfield
Springfield Junction
Cottage Grove
Pleasant Hill
Dougren
Fall Creek
Lowell
Dexter
Jasper
Natron
Goshen
Creswell
Cloverdale
Walterville
Thurston
Marcola
Coburg
Irving
Santa Clara
Spencer Butte
Divide
Dorena
Culp Creek
Big Rock
MERIDIAN
WILLAMETTE
Minnow
Saddleblanket
Wimberry Mtn.
Green Mtn.
Blue Mtn.
Walker Point
Goat Mtn.
Elkhead
Saginaw
Camas Swale

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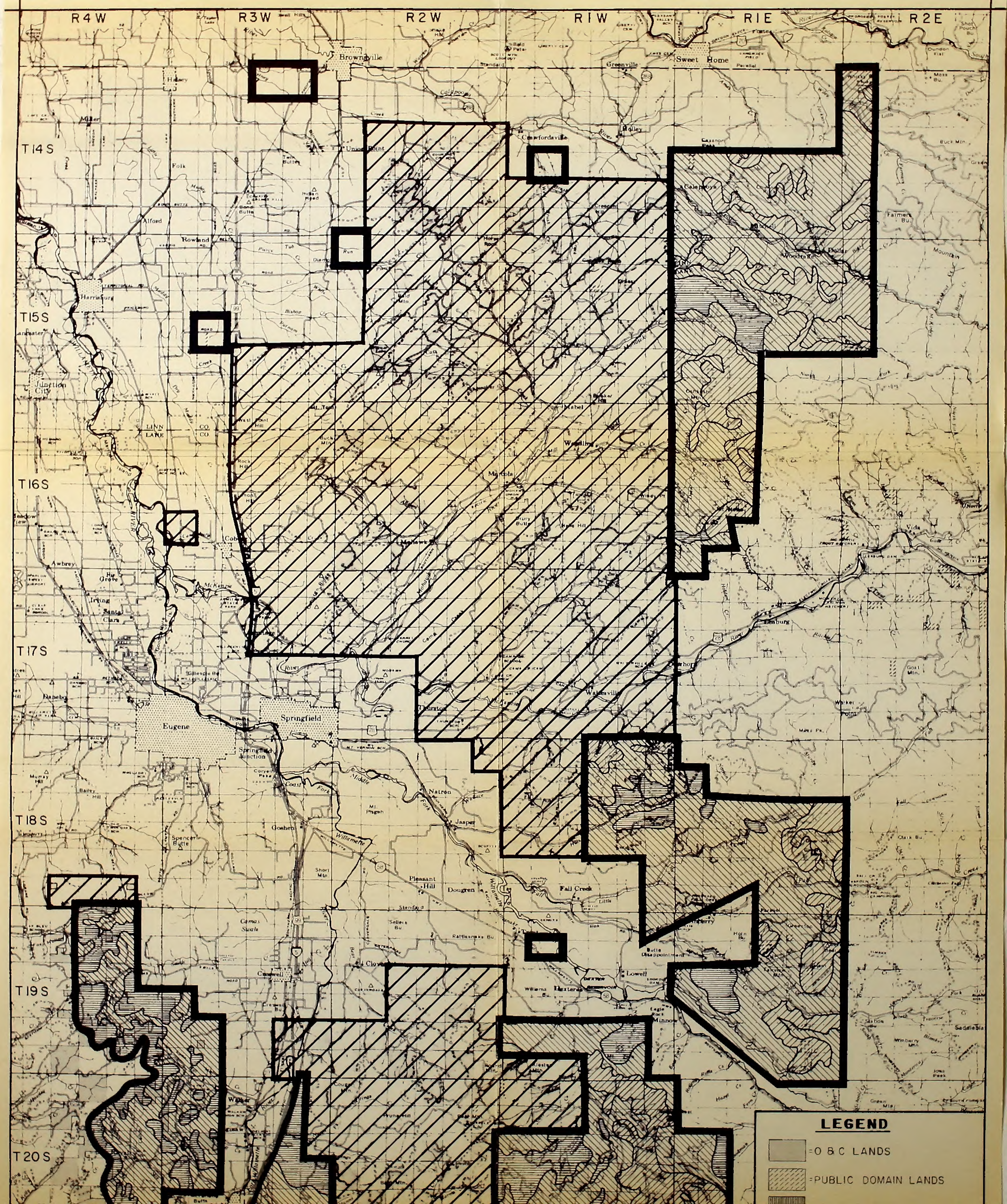
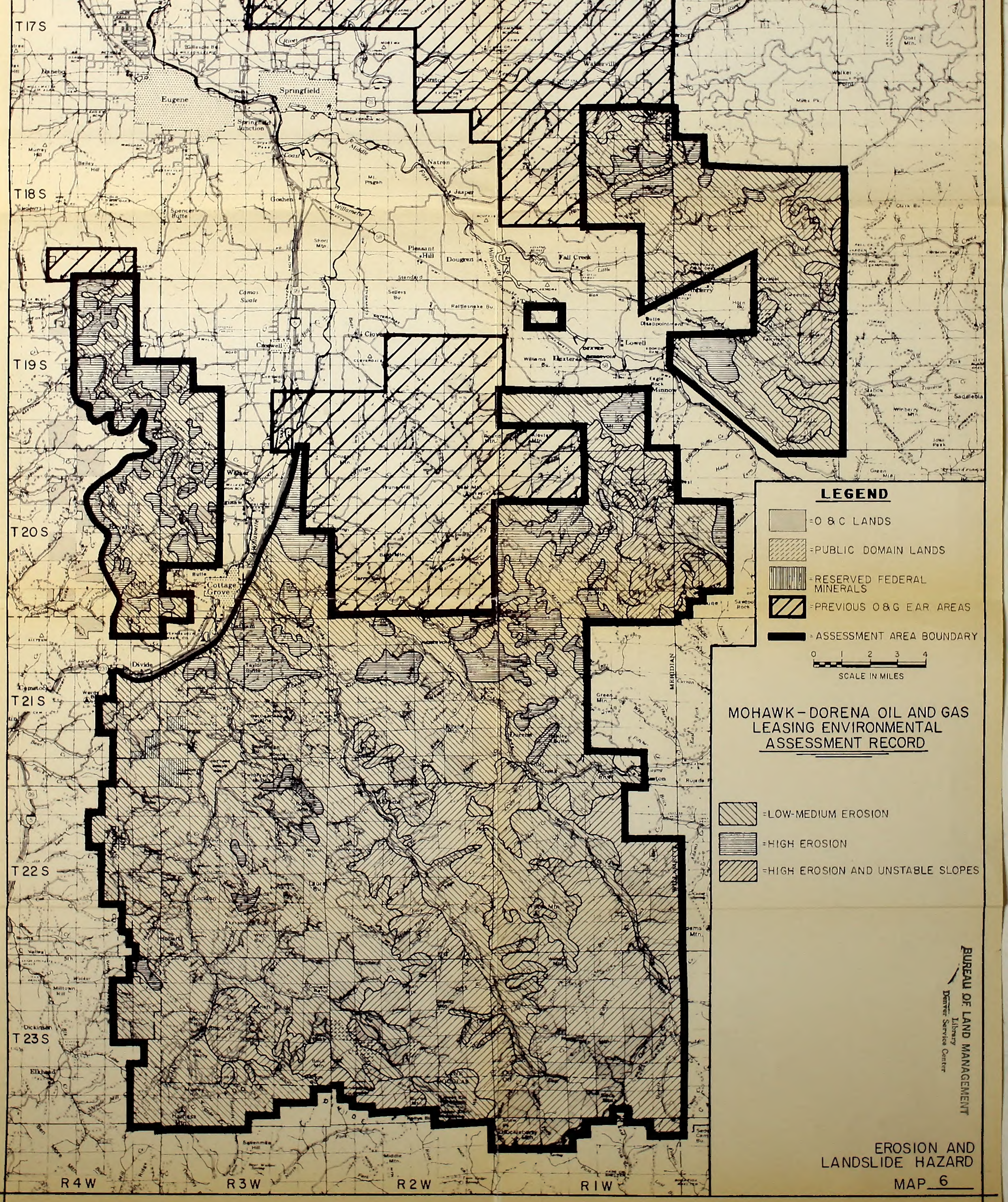

R4W
R3W
R2W
R1W
R1E
R2E
T14S
T15S
T16S
T17S
T18S
T19S
T20S
Brownsville
Sweet Home
Greenville
Crawfordsville
Holley
Union Point
Folk
Alford
Rowland
Harrisburg
Junction City
LINN
LANE
Coburg
Awbrey
Irving
Santa Clara
Mt. Tom
Mabel
Wendling
Marcola
Mohawk
Vida
Leaburg
Thurston
Walterville
Eugene
Springfield
Springfield Junction
Goshen
Natron
Jasper
Pleasant Hill
Dougren
Fall Creek
Lowell
Dexter
Cloverdale
Creswell
Camas Swale
Spencer Butte
Walker
Butte Disappointment
Walker Point
Goat Mtn.
Clark Bu
Saddleblaze
LEGEND
=O & C LANDS
▨ =PUBLIC DOMAIN LANDS


LEGEND
▨ = O & C LANDS
▨ = PUBLIC DOMAIN LANDS
▥ = RESERVED FEDERAL MINERALS
▨ = PREVIOUS O & G EAR AREAS
▬ = ASSESSMENT AREA BOUNDARY
0 1 2 3 4
SCALE IN MILES
▨ = LOW-MEDIUM EROSION
▤ = HIGH EROSION
▨ = HIGH EROSION AND UNSTABLE SLOPES
T17S
T18S
T19S
T20S
T21S
T22S
T23S
R4W
R3W
R2W
R1W
MERIDIAN
Eugene
Springfield
Springfield Junction
Goshen
Spencer Butte
Pleasant Hill
Dougren
Natron
Jasper
Fall Creek
Lowell
Dexter
Thurston
Walterville
Creswell
Camas Swale
Cottage Grove
Divide
London
Dorena
Minnow
Saginaw
Walker
Cloverdale
Elkhead
Dickinson
Comstock
Saddleblanket
Green Mtn.
Bohemia

MOHAWK - DORENA OIL AND GAS LEASING ENVIRONMENTAL ASSESSMENT RECORD

EROSION AND LANDSLIDE HAZARD

MAP 6

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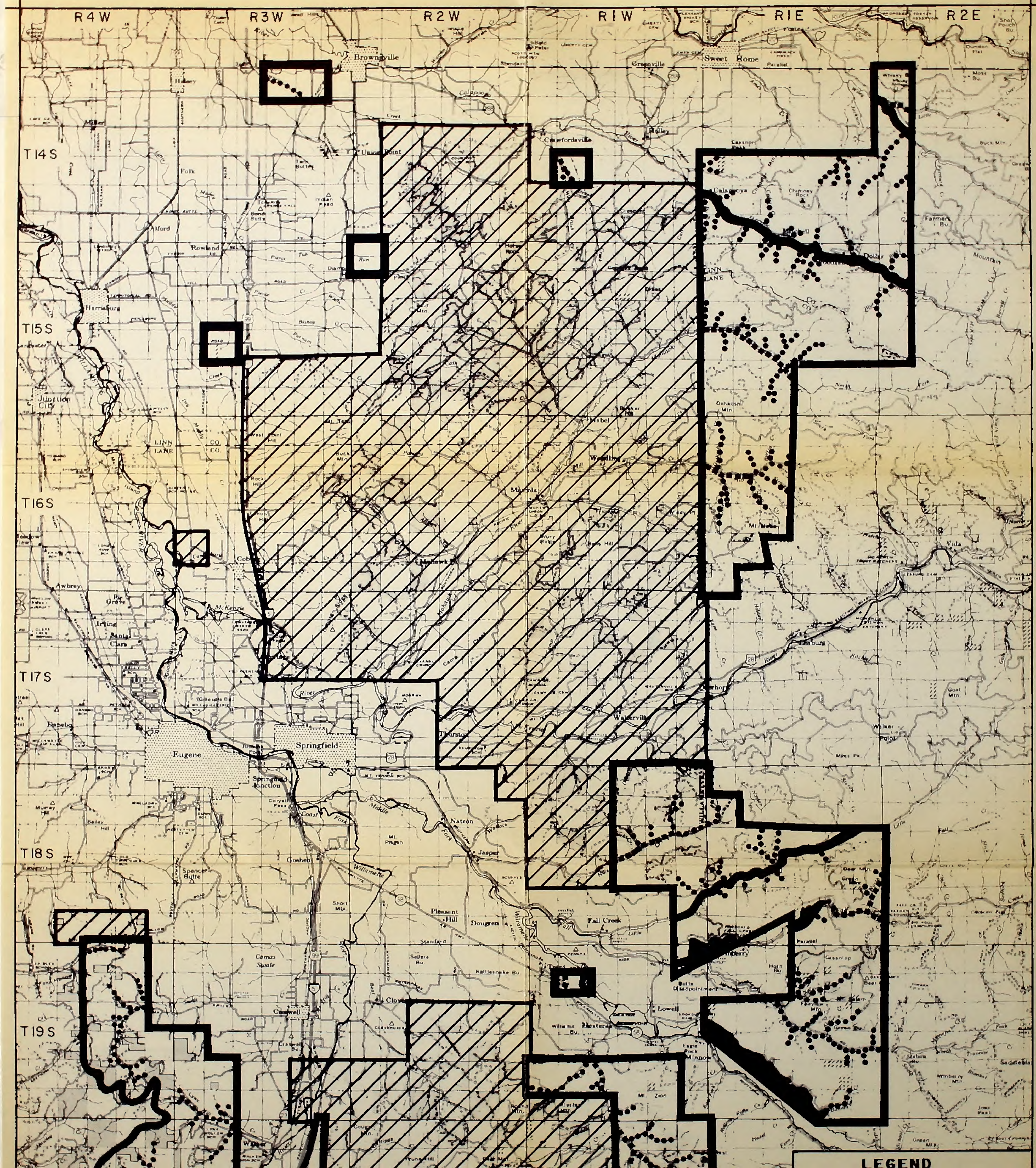
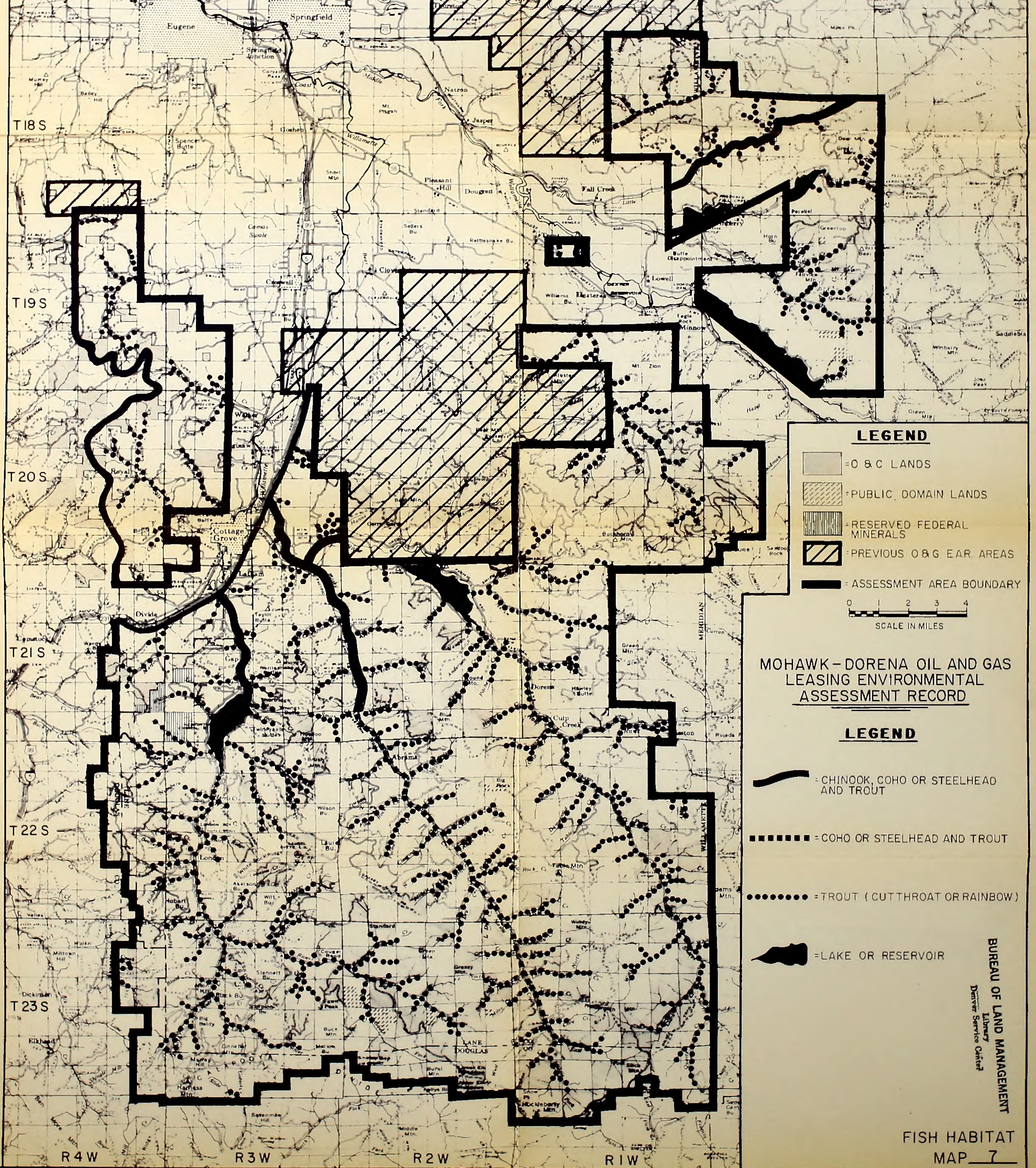

R4W
R3W
R2W
R1W
R1E
R2E
T14S
T15S
T16S
T17S
T18S
T19S
Brownsville
Sweet Home
Crawfordsville
Holley
Greenville
Union Point
Halsey
Folk
Alford
Rowland
Harrisburg
Junction City
Calapooya
Mabel
Wendling
Marcola
Mohawk
Coburg
McKenzie
Irving
Santa Clara
Eugene
Springfield
Springfield Junction
Thurston
Walterville
Natron
Jasper
Goshen
Pleasant Hill
Dougren
Fall Creek
Lowell
Dexter
Creswell
Cloverdale
Camas Swale
Leaburg
Vida
Mt. Nebo
Walker Point
Spencer Butte
Minnow
Unity
Trent
Disappointment Butte
Eagle Rock
Mt. Zion
Saddleblanket
LEGEND


LEGEND
▨ =O & C LANDS
▨ =PUBLIC DOMAIN LANDS
▥ =RESERVED FEDERAL MINERALS
▨ =PREVIOUS O & G EAR AREAS
■ = ASSESSMENT AREA BOUNDARY
0 1 2 3 4
SCALE IN MILES
MOHAWK – DORENA OIL AND GAS LEASING ENVIRONMENTAL ASSESSMENT RECORD
LEGEND
= CHINOOK, COHO OR STEELHEAD AND TROUT
= COHO OR STEELHEAD AND TROUT
= TROUT (CUTTHROAT OR RAINBOW)
= LAKE OR RESERVOIR
FISH HABITAT
MAP 7
T18S
T19S
T20S
T21S
T22S
T23S
R4W
R3W
R2W
R1W
Eugene
Springfield
Springfield Junction
Goshen
Jasper
Natron
Pleasant Hill
Dougren
Fall Creek
Lowell
Dexter
Creswell
Cloverdale
Cottage Grove
Saginaw
Walker
Latham
Divide
Dorena
Culp Creek
Abrams
London
Royal
Spencer Butte
Mt. Zion
Buckhorn Mtn.
Minnow
Lane
Douglas
Willamette
Meridian
Big Rock
Table Mtn.

BUREAU OF LAND MANAGEMENT
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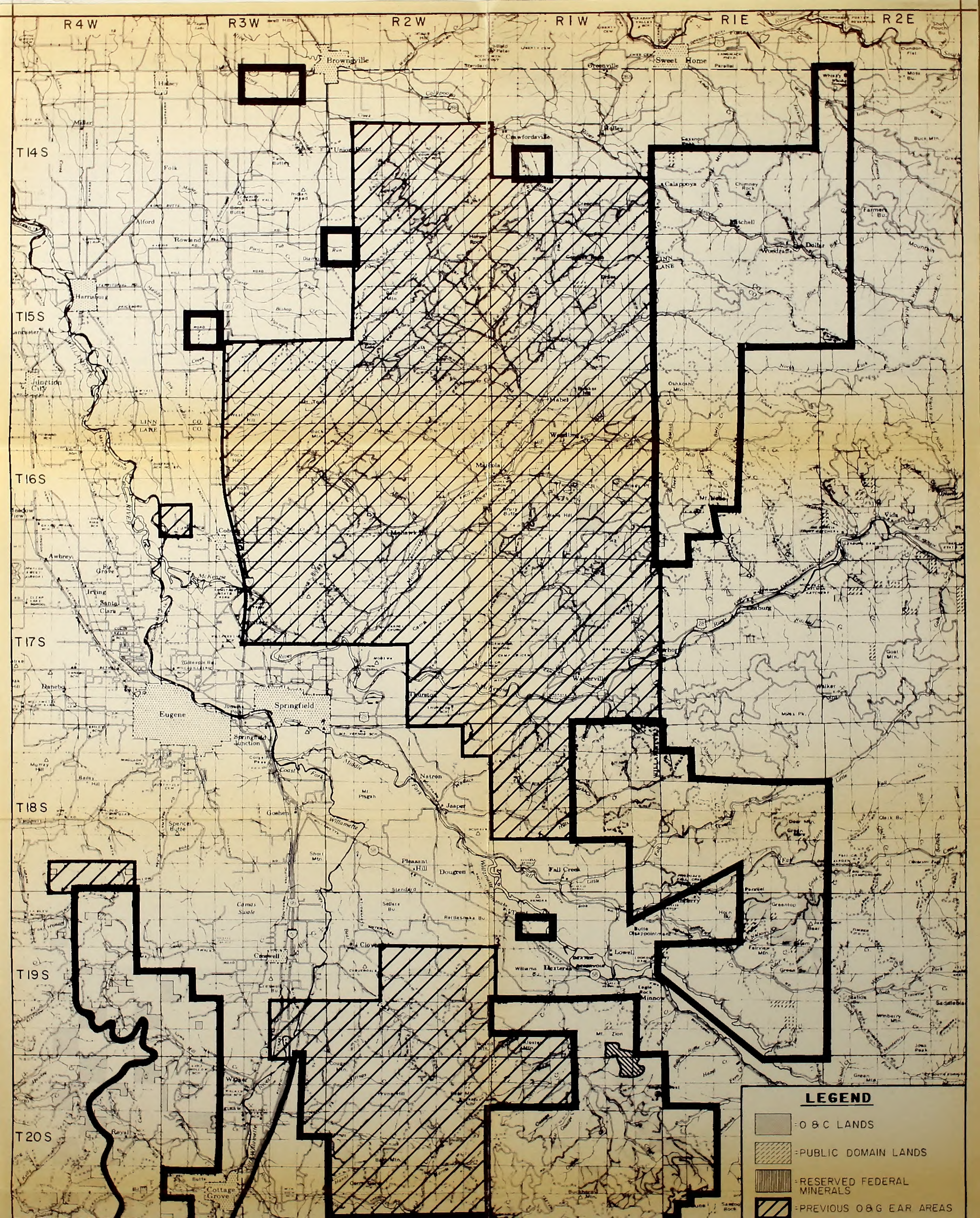
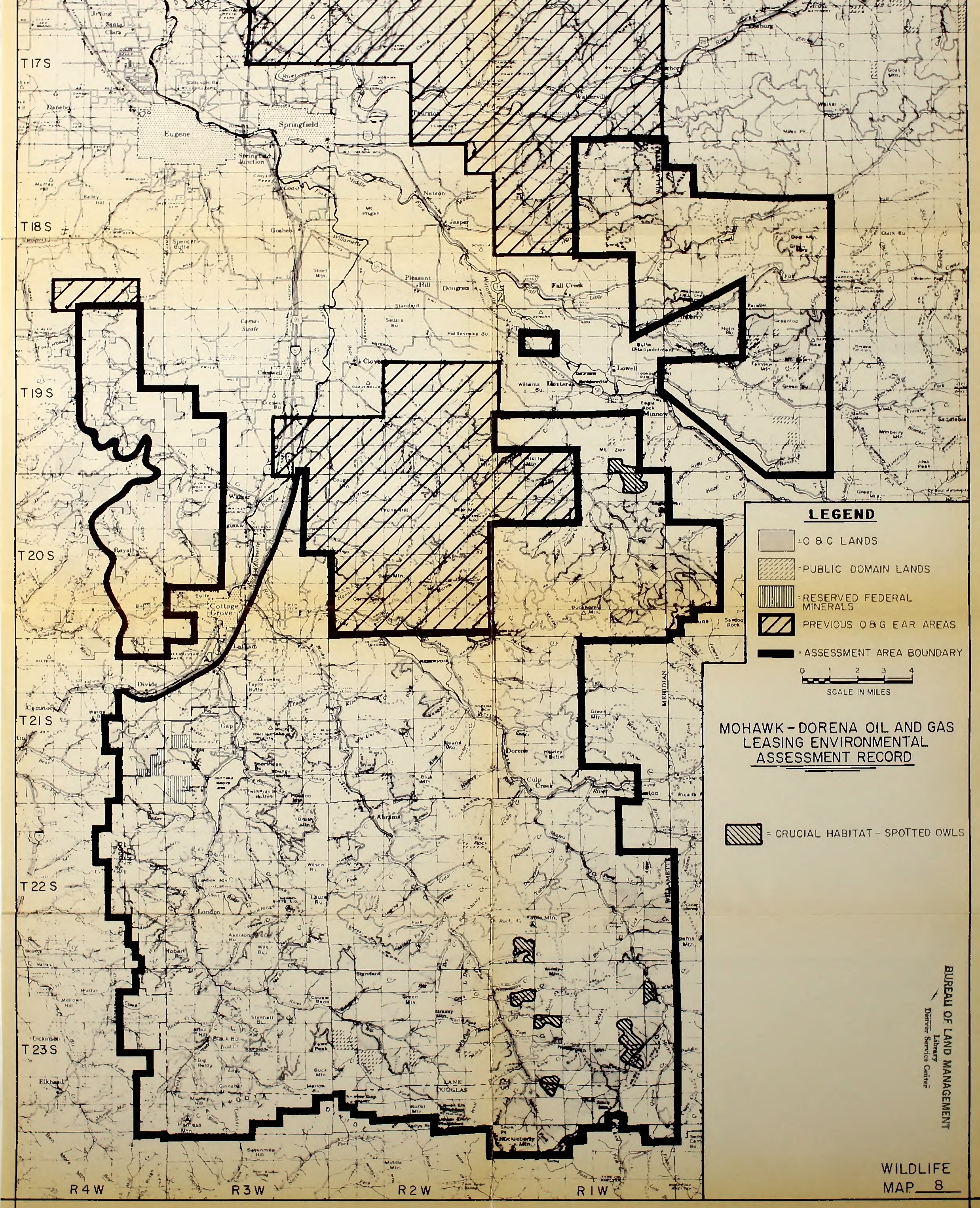

R4W
R3W
R2W
R1W
R1E
R2E
T14S
T15S
T16S
T17S
T18S
T19S
T20S
Brownsville
Sweet Home
Halsey
Crawfordsville
Holley
Union Point
Harrisburg
Junction City
Coburg
Eugene
Springfield
Thurston
Walterville
Marcola
Mabel
Wendling
Jasper
Natron
Goshen
Pleasant Hill
Dougren
Fall Creek
Lowell
Dexter
Cottage Grove
Creswell
Vida
Leaburg
LEGEND
= O & C LANDS
= PUBLIC DOMAIN LANDS
= RESERVED FEDERAL MINERALS
= PREVIOUS O & G EAR AREAS


LEGEND
= O & C LANDS
= PUBLIC DOMAIN LANDS
= RESERVED FEDERAL MINERALS
= PREVIOUS O & G EAR AREAS
= ASSESSMENT AREA BOUNDARY
0 1 2 3 4
SCALE IN MILES
= CRUCIAL HABITAT - SPOTTED OWLS
T17S
T18S
T19S
T20S
T21S
T22S
T23S
R4W
R3W
R2W
R1W
Eugene
Springfield
Springfield Junction
Goshen
Pleasant Hill
Jasper
Natron
Thurston
Walterville
Fall Creek
Lowell
Dexter
Cottage Grove
Divide
Dorena
Culp Creek
London
Saginaw
Creswell
Cloverdale
Walker
Mt. Zion
Short Mtn.
Spencer Butte
Camas Swale
Bear Mtn.
Buckhorn Mtn.
Taylor Butte
Hawley Butte
Blue Mtn.
Round Mtn.
Abrams
Huckleberry Mtn.
Harness Mtn.
Meridian
Willamette

MOHAWK - DORENA OIL AND GAS LEASING ENVIRONMENTAL ASSESSMENT RECORD

WILDLIFE
MAP 8

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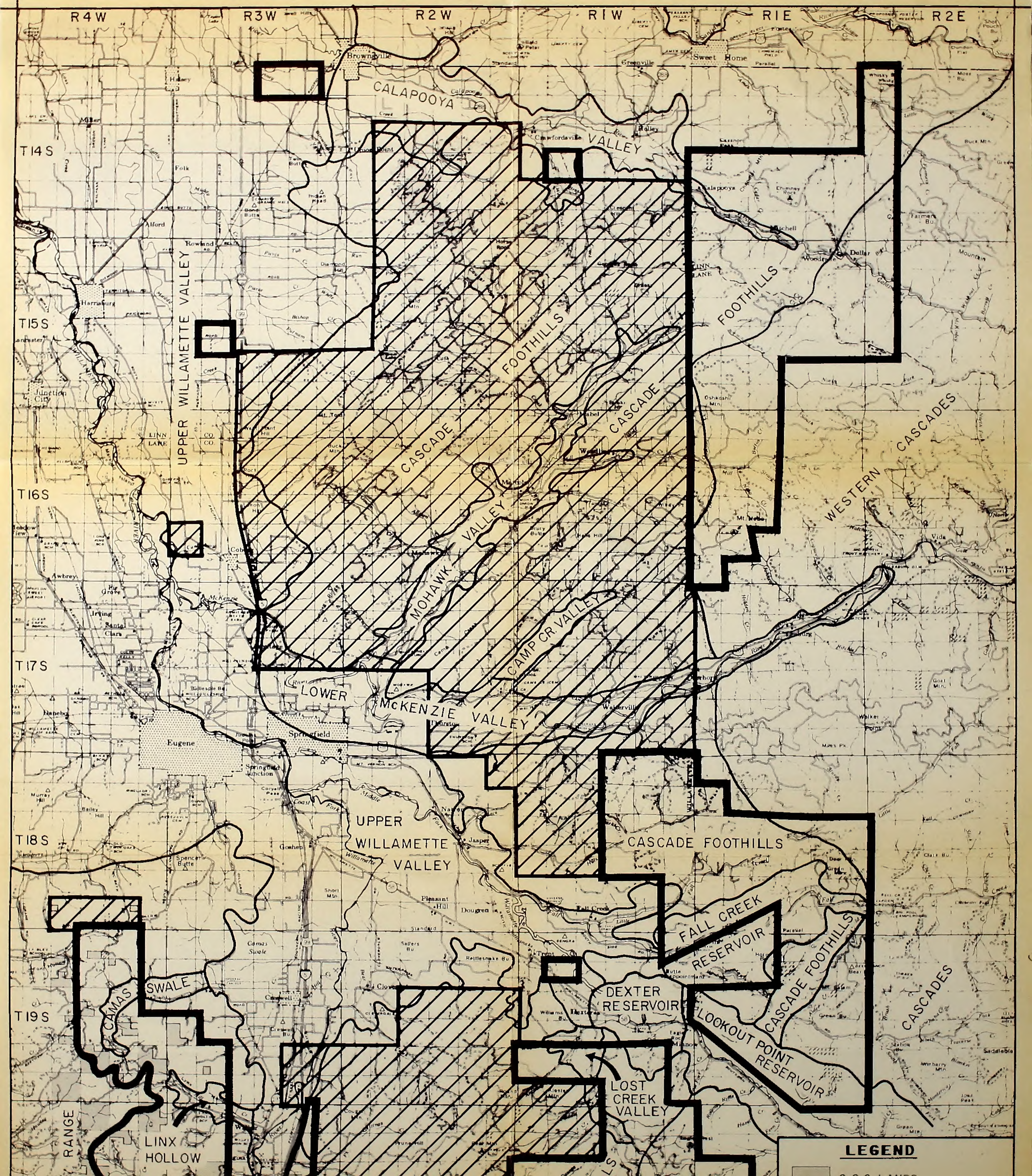
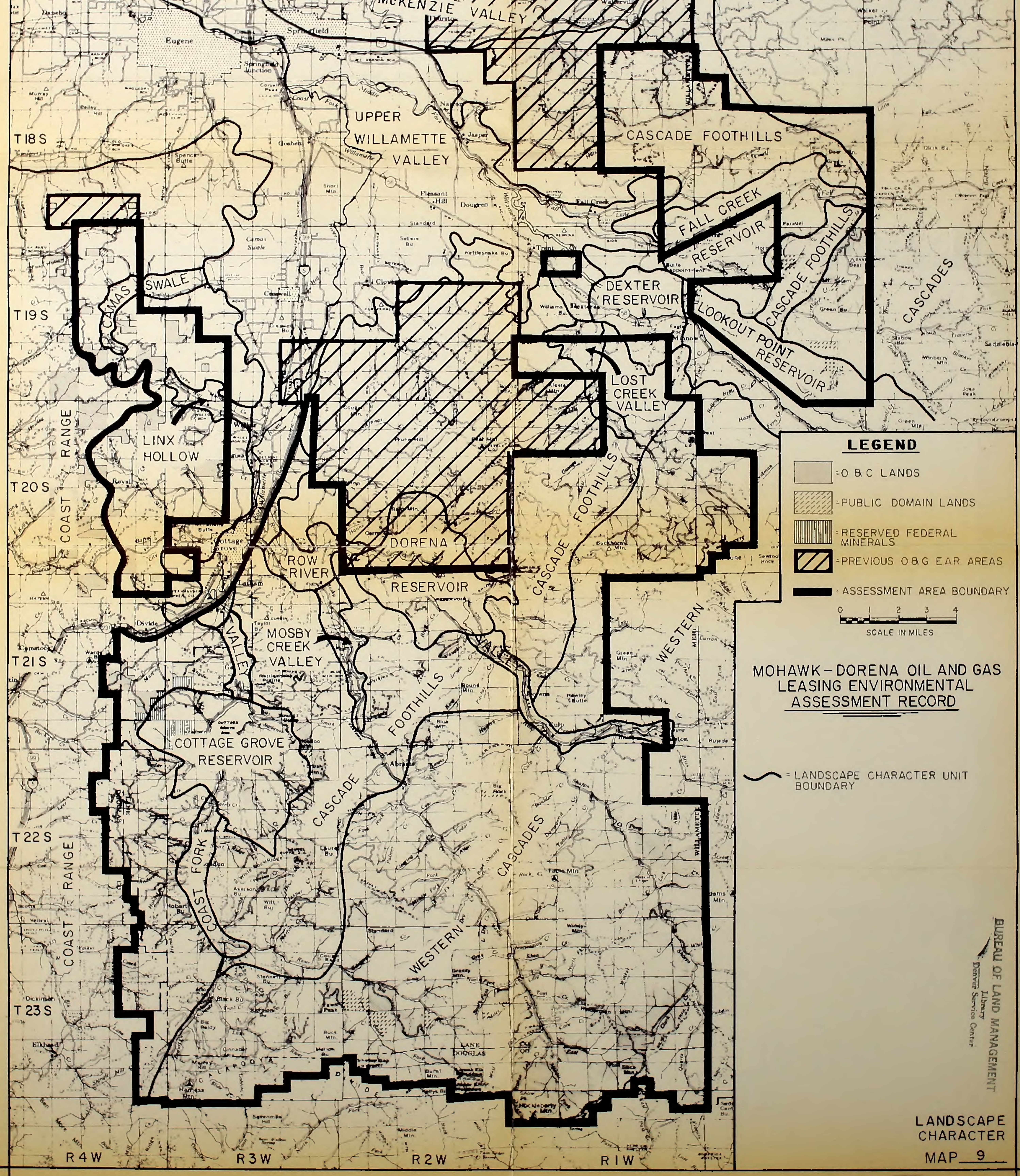

R4W
R3W
R2W
R1W
R1E
R2E
T14S
T15S
T16S
T17S
T18S
T19S
CALAPOOYA
VALLEY
Brownsville
Sweet Home
Crawfordsville
Halsey
Harrisburg
Junction City
UPPER WILLAMETTE VALLEY
CASCADE FOOTHILLS
FOOTHILLS
CASCADE
MOHAWK VALLEY
CAMP CR VALLEY
WESTERN CASCADES
LINN LANE
LINN CO
LANE CO
Coburg
Eugene
Springfield
LOWER McKENZIE VALLEY
UPPER WILLAMETTE VALLEY
CASCADE FOOTHILLS
FALL CREEK RESERVOIR
DEXTER RESERVOIR
LOOKOUT POINT RESERVOIR
CASCADE FOOTHILLS
CASCADES
CAMAS SWALE
LOST CREEK VALLEY
LINX HOLLOW
RANGE
LEGEND


McKENZIE VALLEY
Eugene
Springfield
UPPER WILLAMETTE VALLEY
CASCADE FOOTHILLS
FALL CREEK RESERVOIR
DEXTER RESERVOIR
LOOKOUT POINT RESERVOIR
CASCADES
CAMAS SWALE
LINX HOLLOW
LOST CREEK VALLEY
COAST RANGE
DORENA
ROW RIVER
RESERVOIR
MOSBY CREEK VALLEY
VALLEY
COTTAGE GROVE RESERVOIR
COAST FORK
WESTERN CASCADE FOOTHILLS
WESTERN CASCADES
T18S
T19S
T20S
T21S
T22S
T23S
R4W
R3W
R2W
R1W
LEGEND
= O & C LANDS
= PUBLIC DOMAIN LANDS
= RESERVED FEDERAL MINERALS
= PREVIOUS O & G EAR AREAS
= ASSESSMENT AREA BOUNDARY
0 1 2 3 4
SCALE IN MILES
= LANDSCAPE CHARACTER UNIT BOUNDARY

MOHAWK - DORENA OIL AND GAS LEASING ENVIRONMENTAL ASSESSMENT RECORD

LANDSCAPE CHARACTER

MAP 9

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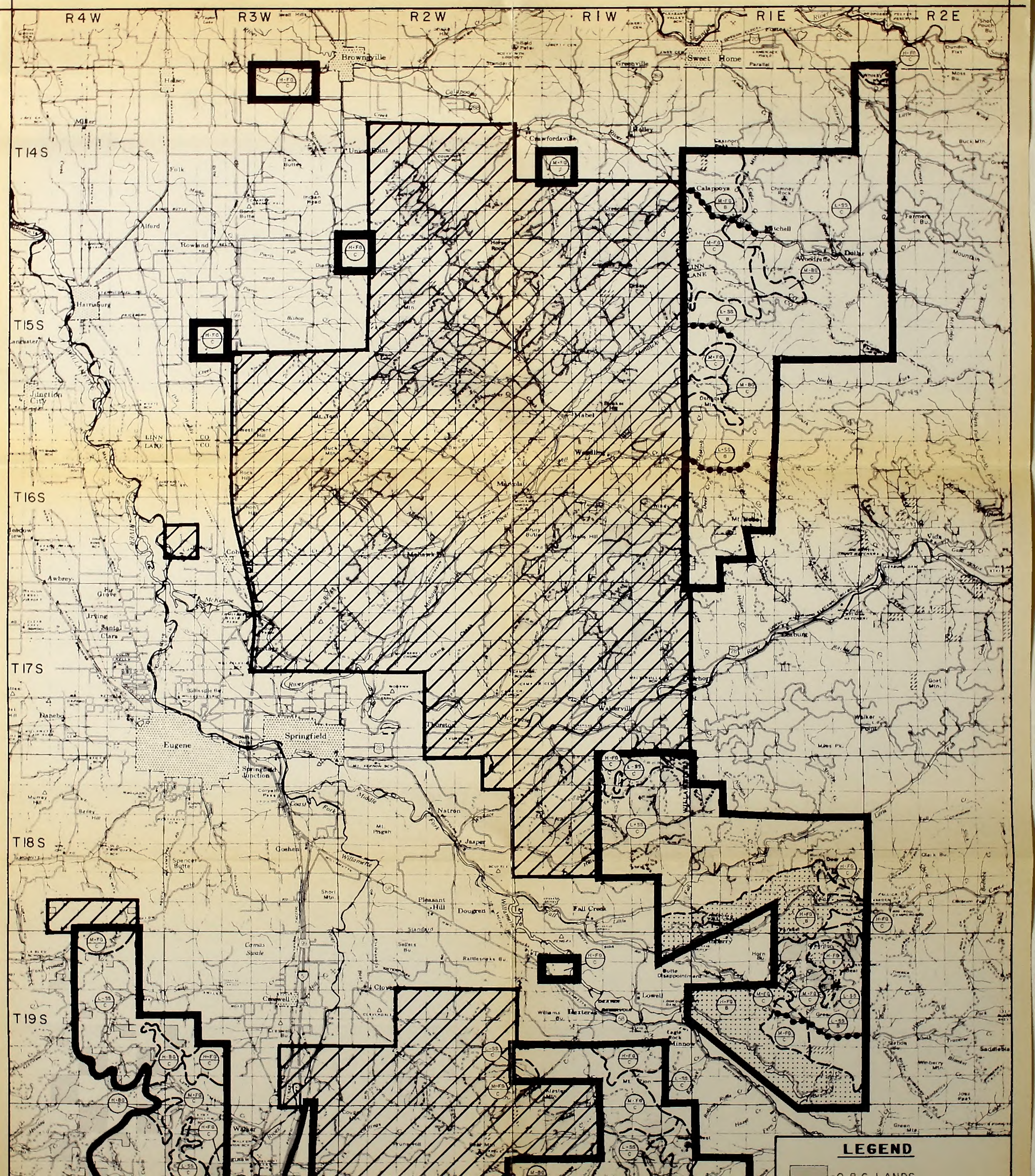
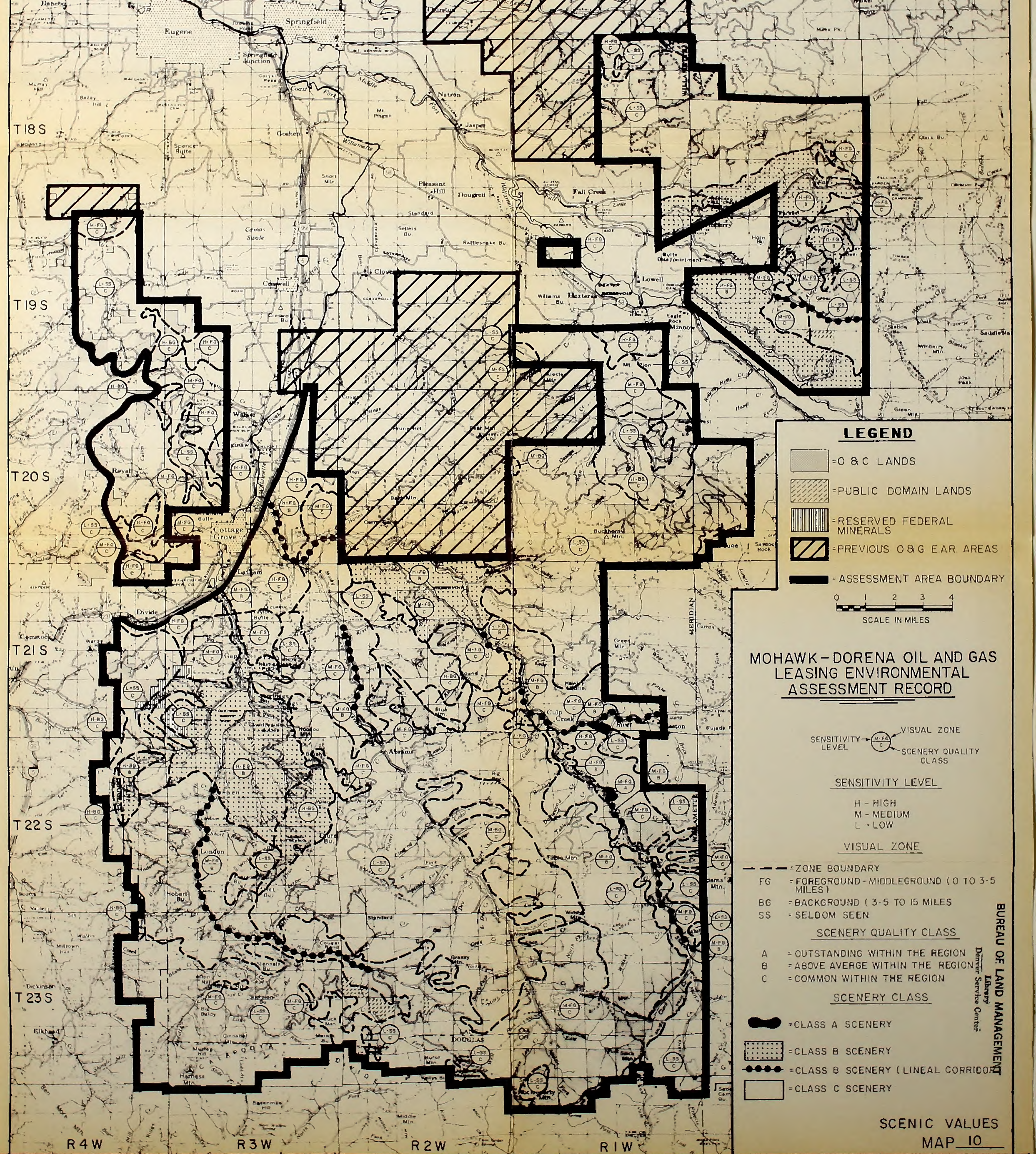

R4W
R3W
R2W
R1W
R1E
R2E
T14S
T15S
T16S
T17S
T18S
T19S
Brownsville
Sweet Home
Crawfordsville
Holley
Union Point
Halsey
Harrisburg
Junction City
Calapooya
Mitchell
Dollar
Woodruffe
Mabel
Wendling
Marcola
Mohawk
Coburg
Thurston
Walterville
Vida
Leaburg
Eugene
Springfield
Natron
Jasper
Goshen
Pleasant Hill
Dougren
Fall Creek
Lowell
Dexter
Creswell
Cloverdale
Minnow
LINN
LANE
H-FG
M-FG
M-BG
L-SS
H-BG
B
C
LEGEND
O.&C. LANDS


Eugene
Springfield
Springfield Junction
Natron
Jasper
Goshen
Pleasant Hill
Dougren
Fall Creek
Lowell
Dexter
Minnow
Mt. Zion
Camas Swale
Creswell
Walker
Cottage Grove
Divide
Culp Creek
Abrams
Standard
London
Dorena
Blue Mtn.
Bear Mtn.
Green Mtn.
Buckhorn Mtn.
Harness Mtn.
Hobart Bu.
Dickinson
Elkhead
T18S
T19S
T20S
T21S
T22S
T23S
R4W
R3W
R2W
R1W
WILLAMETTE MERIDIAN
LEGEND
= O & C LANDS
= PUBLIC DOMAIN LANDS
= RESERVED FEDERAL MINERALS
= PREVIOUS O&G EAR AREAS
= ASSESSMENT AREA BOUNDARY
0 1 2 3 4
SCALE IN MILES
SENSITIVITY LEVEL
VISUAL ZONE
SCENERY QUALITY CLASS
M-FG C
SENSITIVITY LEVEL
H - HIGH
M - MEDIUM
L - LOW
VISUAL ZONE
= ZONE BOUNDARY
FG = FOREGROUND - MIDDLEGROUND (0 TO 3-5 MILES)
BG = BACKGROUND (3-5 TO 15 MILES
SS = SELDOM SEEN
SCENERY QUALITY CLASS
A = OUTSTANDING WITHIN THE REGION
B = ABOVE AVERGE WITHIN THE REGION
C = COMMON WITHIN THE REGION
SCENERY CLASS
= CLASS A SCENERY
= CLASS B SCENERY
= CLASS B SCENERY (LINEAL CORRIDOR)
= CLASS C SCENERY

MOHAWK - DORENA OIL AND GAS LEASING ENVIRONMENTAL ASSESSMENT RECORD

SCENIC VALUES

MAP 10

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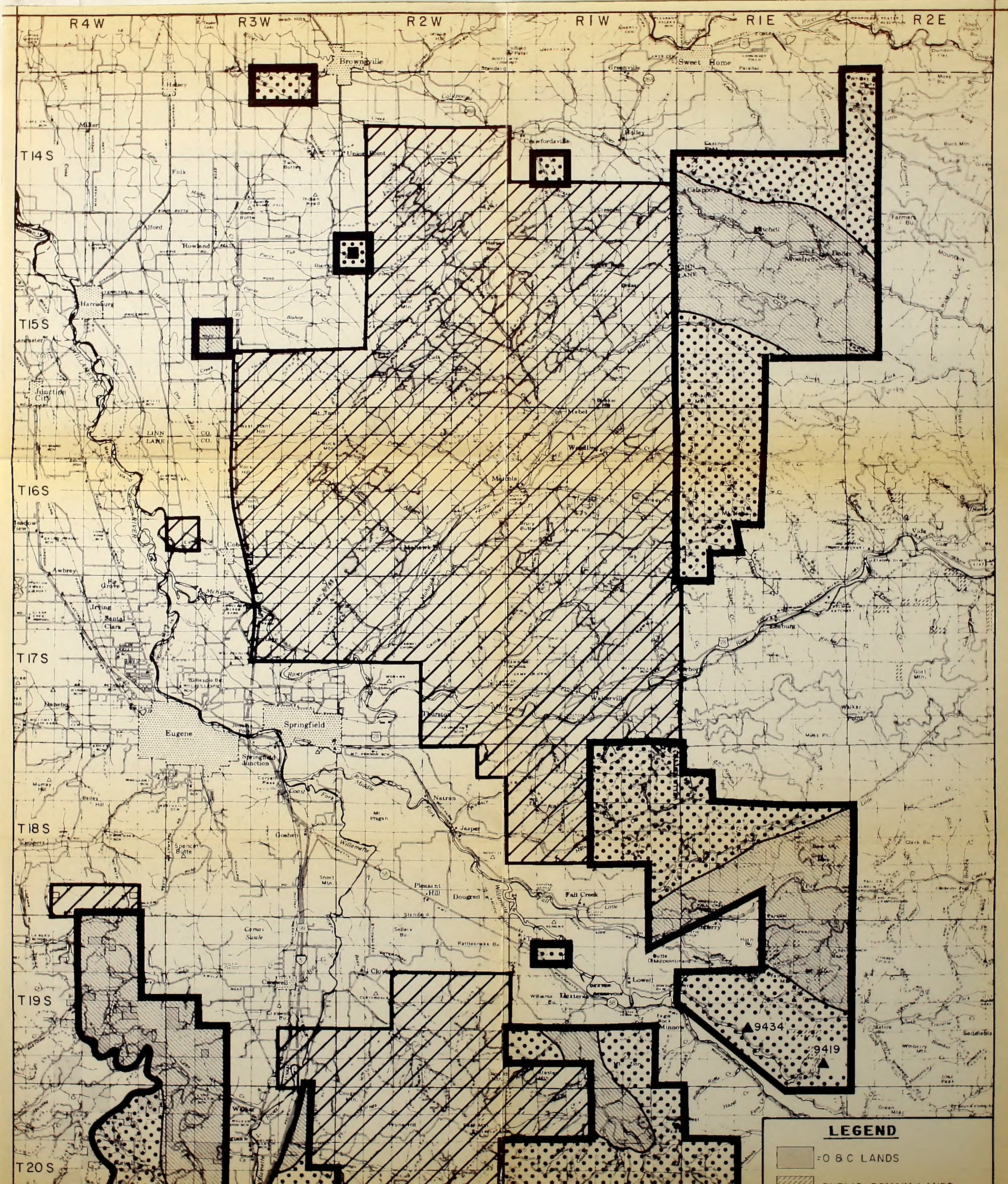
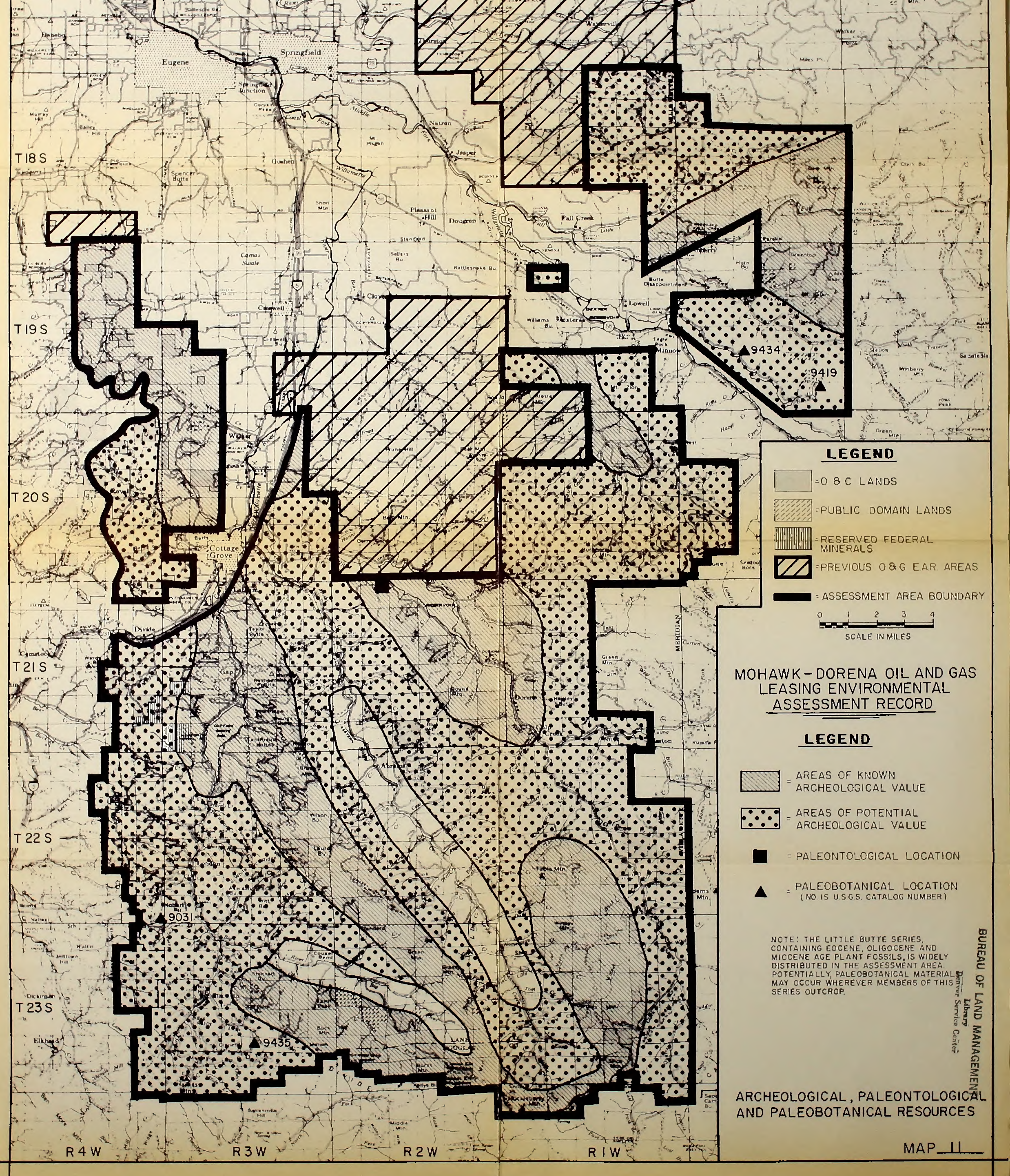

R4W
R3W
R2W
R1W
R1E
R2E
T14S
T15S
T16S
T17S
T18S
T19S
T20S
Brownsville
Sweet Home
Halsey
Crawfordsville
Holley
Greenville
Union Point
Twin Buttes
Miller
Folk
Alford
Rowland
Harrisburg
Junction City
LINN
LANE
CO.
CO.
Calapooya
Mitchell
Woodruff
Crescent
Marcola
Mabel
Wendling
Mohawk
Coburg
Awbrey
Irving
Santa Clara
Eugene
Springfield
Springfield Junction
Thurston
Walterville
Leaburg
Vida
Natron
Jasper
Goshen
Pleasant Hill
Dougren
Fall Creek
Lowell
Dexter
Creswell
Cloverdale
Camas Swale
Spencer Butte
Walker
Minnow
Butte Disappointment
9434
9419
LEGEND
=O & C LANDS



LEGEND
=O & C LANDS
=PUBLIC DOMAIN LANDS
=RESERVED FEDERAL MINERALS
=PREVIOUS O & G EAR AREAS
= ASSESSMENT AREA BOUNDARY
0 1 2 3 4
SCALE IN MILES
LEGEND
= AREAS OF KNOWN ARCHEOLOGICAL VALUE
= AREAS OF POTENTIAL ARCHEOLOGICAL VALUE
= PALEONTOLOGICAL LOCATION
= PALEOBOTANICAL LOCATION (NO IS U.S.G.S. CATALOG NUMBER)
9434
9419
9031
9435
T18S
T19S
T20S
T21S
T22S
T23S
R4W
R3W
R2W
R1W
MERIDIAN
Eugene
Springfield
Springfield Junction
Goshen
Pleasant Hill
Dougren
Fall Creek
Jasper
Natron
Lowell
Dexter
Minnow
Cottage Grove
Divide
Dorena
London
Walker

MOHAWK-DORENA OIL AND GAS LEASING ENVIRONMENTAL ASSESSMENT RECORD

NOTE: THE LITTLE BUTTE SERIES, CONTAINING EOCENE, OLIGOCENE AND MIOCENE AGE PLANT FOSSILS, IS WIDELY DISTRIBUTED IN THE ASSESSMENT AREA. POTENTIALLY, PALEOBOTANICAL MATERIAL MAY OCCUR WHEREVER MEMBERS OF THIS SERIES OUTCROP.

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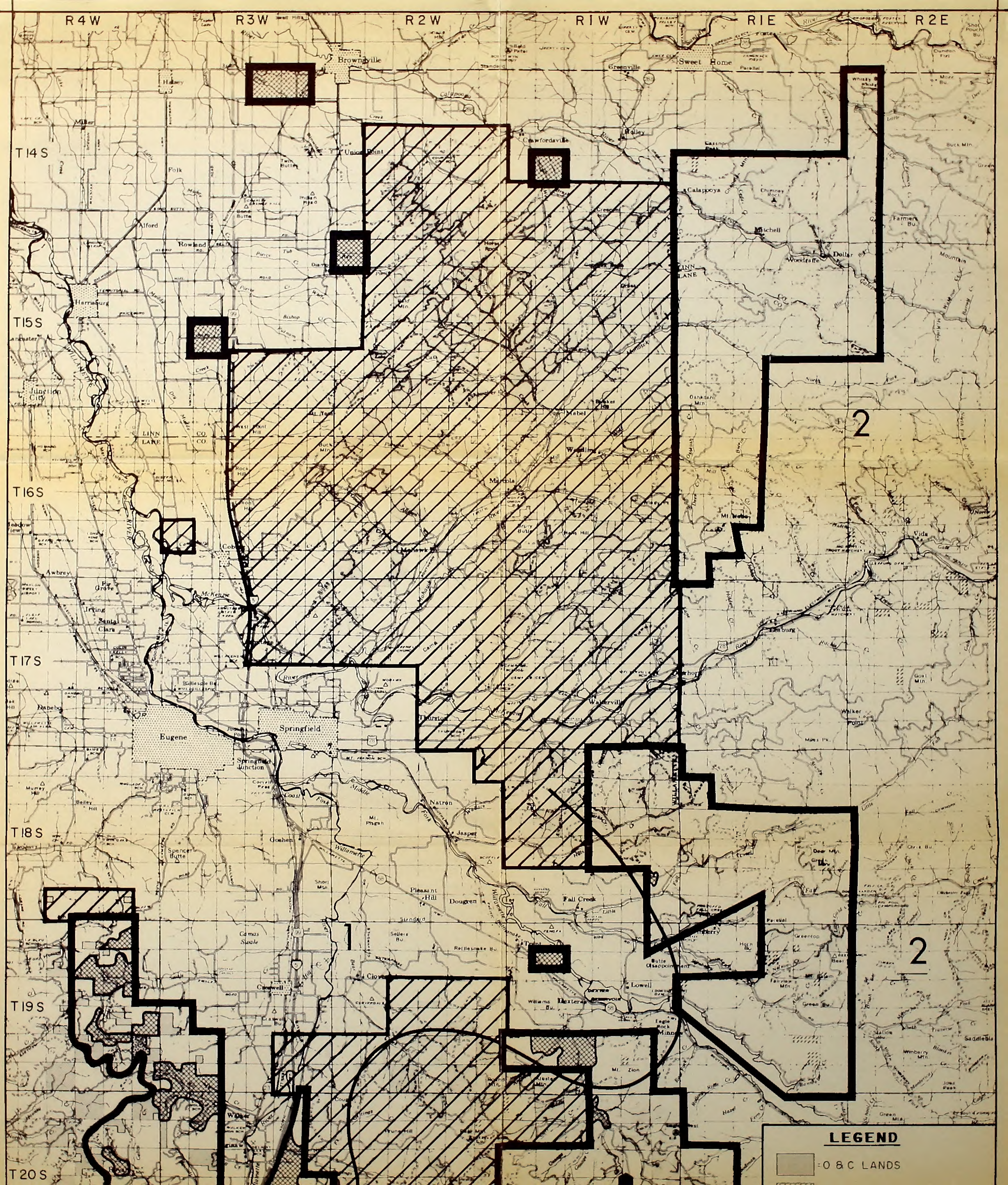
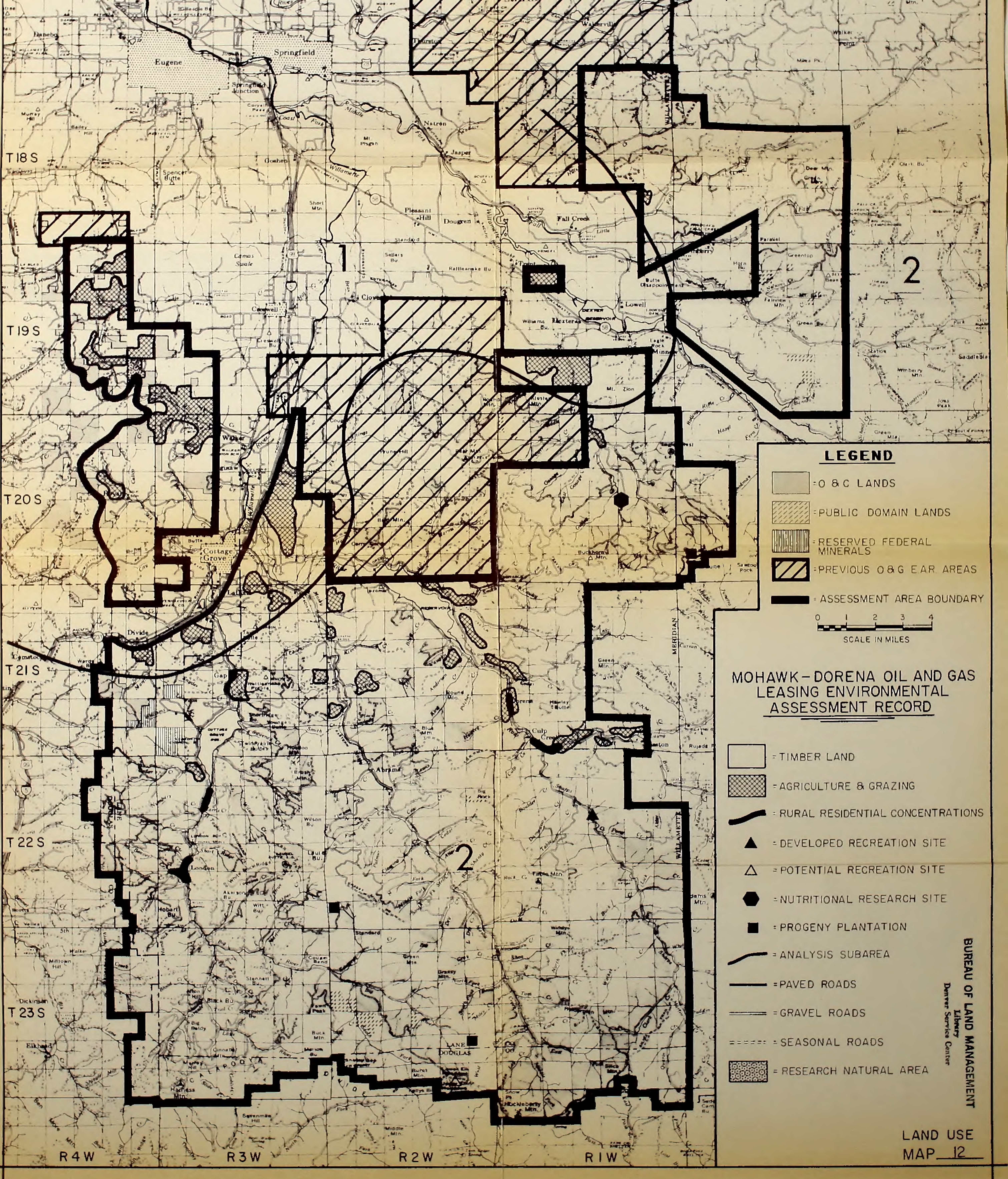
ARCHEOLOGICAL, PALEONTOLOGICAL AND PALEOBOTANICAL RESOURCES

MAP 11


R4W
R3W
R2W
R1W
R1E
R2E
T14S
T15S
T16S
T17S
T18S
T19S
T20S
Brownsville
Halsey
Sweet Home
Greenville
Holley
Crawfordsville
Union Point
Calapooya
Harrisburg
Junction City
Alford
Rowland
Miller
Folk
Mitchell
Dollar
Woodruffe
Crescent
Mabel
Wendling
Marcola
Mohawk
Coburg
Awbrey
Irving
Santa Clara
Eugene
Springfield
Springfield Junction
Thurston
Walterville
Leaburg
Vida
Natron
Jasper
Goshen
Pleasant Hill
Dougren
Fall Creek
Lowell
Dexter
Creswell
Cloverdale
Walker Point
LINN
LANE
CO
CO
WILLAMETTE
1
2
2
LEGEND
= O & C LANDS


LEGEND
▨ = O & C LANDS
▨ = PUBLIC DOMAIN LANDS
▥ = RESERVED FEDERAL MINERALS
▨ = PREVIOUS O & G E.A.R. AREAS
▬ = ASSESSMENT AREA BOUNDARY
0 1 2 3 4
SCALE IN MILES
☐ = TIMBER LAND
▩ = AGRICULTURE & GRAZING
▬ = RURAL RESIDENTIAL CONCENTRATIONS
▲ = DEVELOPED RECREATION SITE
△ = POTENTIAL RECREATION SITE
⬢ = NUTRITIONAL RESEARCH SITE
■ = PROGENY PLANTATION
⁀ = ANALYSIS SUBAREA
— = PAVED ROADS
═ = GRAVEL ROADS
===== = SEASONAL ROADS
▨ = RESEARCH NATURAL AREA
1
2
2
T18S
T19S
T20S
T21S
T22S
T23S
R4W
R3W
R2W
R1W
MERIDIAN
WILLAMETTE
Eugene
Springfield
Springfield Junction
Goshen
Spencer Butte
Pleasant Hill
Dougren
Jasper
Natron
Fall Creek
Lowell
Dexter
Creswell
Camas Swale
Cottage Grove
Divide
Saginaw
Culp Creek
Dorena
London
Hobart Bu.
Mt. Zion
Mt. Pisgah
Walker Point
Walterville
Thurston
Trent
Unity
Lookout Point
Fairview Mtn.
Green Bu.
Eagle Rock
Saddleblanket
Wards Butte
Gap
Blue Mtn.
Abrams
Round Mtn.
Big Rock
Green Mtn.
Grassy Mtn.
Buck Mtn.
Huckleberry Mtn.
Bohemia Mtn.
Calapooya
Harness Mtn.
LANE
DOUGLAS
Elkhead
Dickinson
Milltown
Black Bu.
Hawley Butte

MOHAWK – DORENA OIL AND GAS LEASING ENVIRONMENTAL ASSESSMENT RECORD

LAND USE MAP 12

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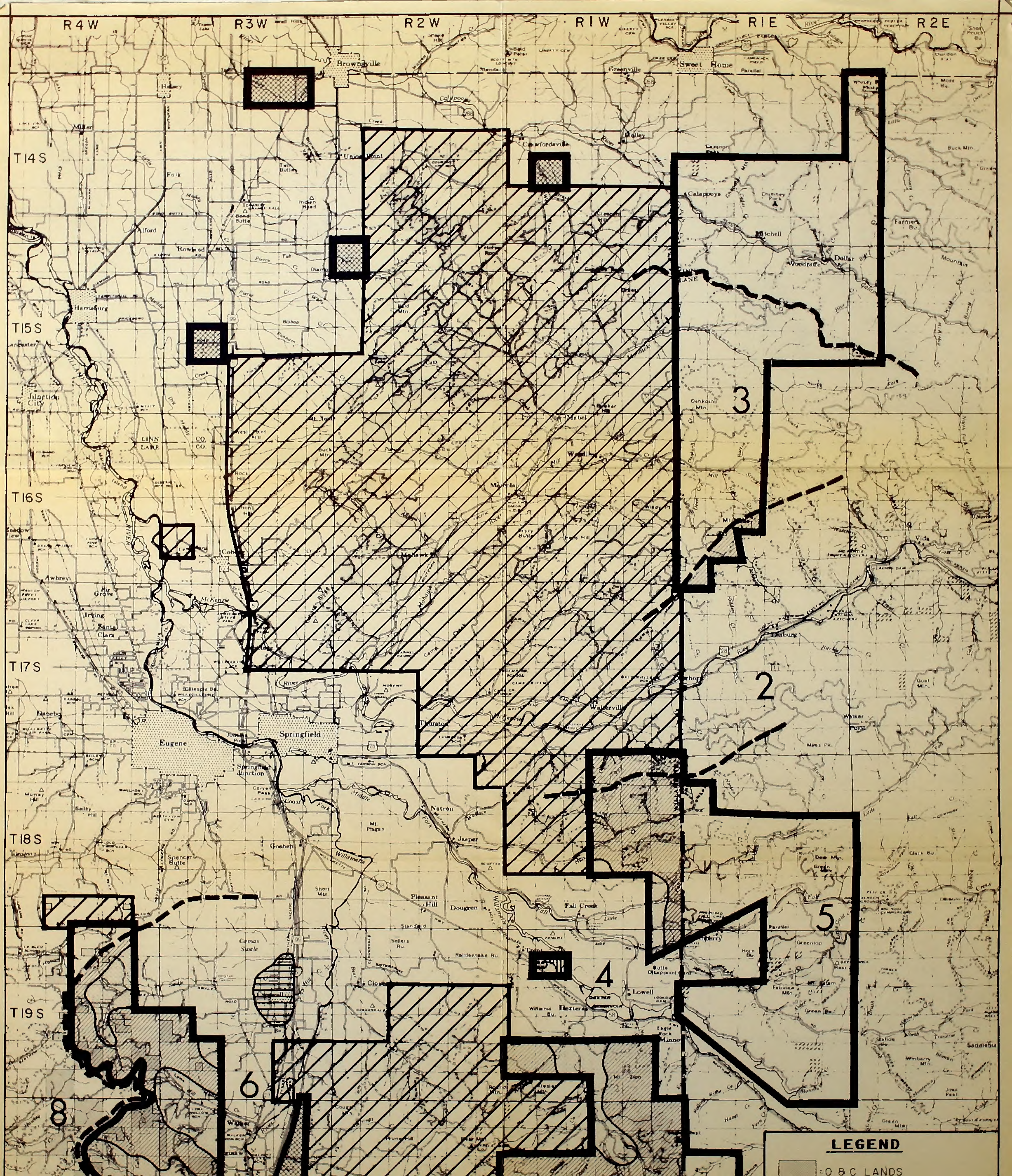
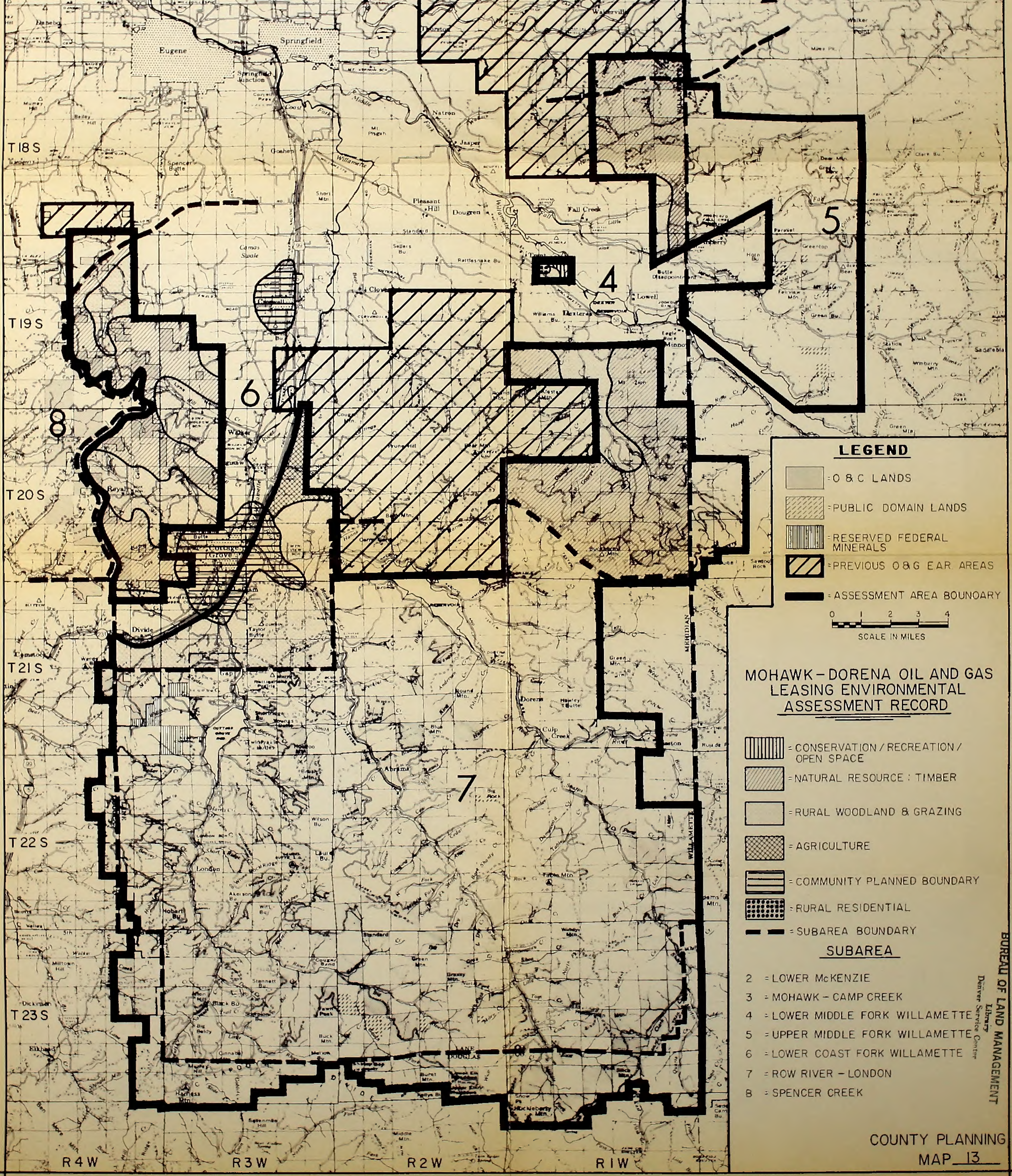

R4W
R3W
R2W
R1W
R1E
R2E
T14S
T15S
T16S
T17S
T18S
T19S
Brownsville
Sweet Home
Greenville
Foster
Calapooya
Crawfordsville
Holley
Halsey
Union Point
Indian Head
Alford
Rowland
Harrisburg
Junction City
LINN
LANE
CO.
Coburg
Crescent
Mabel
Marcola
Wendling
Mohawk
Calapooya
Mitchell
Woodruffe
Dollar
Chimney Rock
Farmers Bu.
Buck Mtn.
Vida
Leaburg
Walterville
Thurston
Springfield
Eugene
Springfield Junction
Natron
Jasper
Goshen
Pleasant Hill
Dougren
Fall Creek
Trent
Lowell
Dexter
Butte Disappointment
Jimberry
Deer Mtn.
Walker Point
Goat Mtn.
Clark Bu.
Greentop
Fairview Mtn.
Mt. Baldy
Green Bu.
Saddleblanket
Wimberry Mtn.
Minnow
Eagle Rock
Williams Bu.
Cloverdale
Creswell
Camas Swale
Spencer Butte
Irving
Santa Clara
Awbrey
Murray Hill
Bailey Hill
Short Mtn.
Rattlesnake Bu.
Sellers Bu.
Walker
Cougar Mtn.
Prune Hill
1
2
3
4
5
6
8
LEGEND
= O & C LANDS



MOHAWK – DORENA OIL AND GAS LEASING ENVIRONMENTAL ASSESSMENT RECORD

COUNTY PLANNING MAP 13

LEGEND
= O & C LANDS
= PUBLIC DOMAIN LANDS
= RESERVED FEDERAL MINERALS
= PREVIOUS O & G EAR AREAS
= ASSESSMENT AREA BOUNDARY
0 1 2 3 4
SCALE IN MILES
= CONSERVATION / RECREATION / OPEN SPACE
= NATURAL RESOURCE : TIMBER
= RURAL WOODLAND & GRAZING
= AGRICULTURE
= COMMUNITY PLANNED BOUNDARY
= RURAL RESIDENTIAL
= SUBAREA BOUNDARY
SUBAREA
2 = LOWER McKENZIE
3 = MOHAWK – CAMP CREEK
4 = LOWER MIDDLE FORK WILLAMETTE
5 = UPPER MIDDLE FORK WILLAMETTE
6 = LOWER COAST FORK WILLAMETTE
7 = ROW RIVER – LONDON
8 = SPENCER CREEK
4
5
6
7
8
T18S
T19S
T20S
T21S
T22S
T23S
R4W
R3W
R2W
R1W
Eugene
Springfield
Springfield Junction
Goshen
Spencer Butte
Pleasant Hill
Dougren
Jasper
Natron
Fall Creek
Lowell
Dexter
Cottage Grove
Divide
Dorena
Culp Creek
London
Royal
Walker
Creswell
Thurston
Walterville
Minnow
Mt. Zion
Bear Mtn.
Taylor Butte
Black Bu.
Buck Mtn.
Hobart Bu.
Wilson Bu.
Green Mtn.
Big Rock
Abrams
Blue Mtn.
Round Mtn.
Willamette
MERIDIAN
WILLAMETTE
LANE
DOUGLAS

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ord for

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